



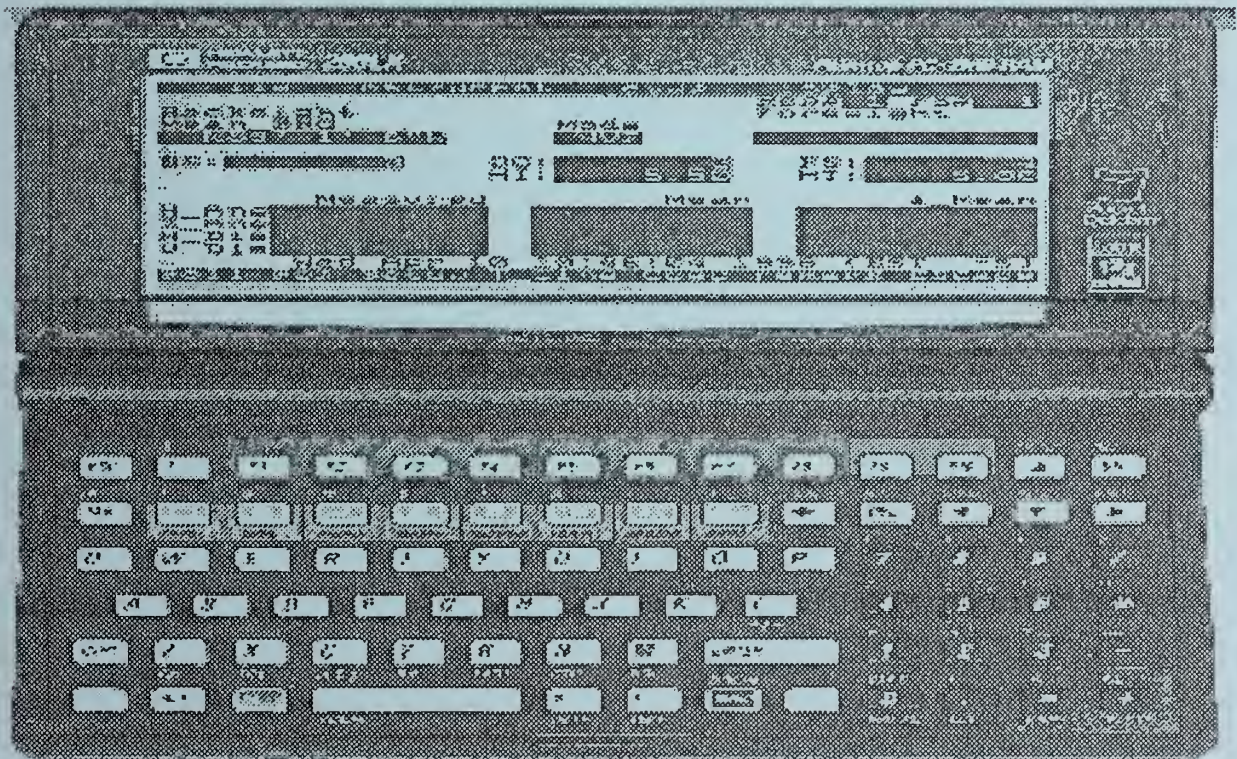
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Bureau of Land Management
Cadastral Survey



Cadastral Electronic Field Book Comprehensive Documentation



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CHAPTER ONE - CEFB - Getting Started

CEFB Quick Start - Reference

Hardware

Hand held PC:	Examples: HP95, HP100, HP200 Paravant RHC-44, etc.
Instrument Cable:	Hand held PC to Instrument, special for each instrument.
HP's:	TDS cable, same as the TDS48 cables.
Paravant:	Serial communications cable.
PC Cable:	Hand held PC to Main PC
HP's:	Same part as for the HP48.
Paravant:	FLX cable, communication & power cable.
RAM Card:	Extremely Beneficial in CEFB data collection.
HP's:	An electronic RAM card is suggested - minimum 512 KB.
Paravant:	An electronic RAM card is required - minimum 512 KB.
Batteries:	2 - Size AA alkaline batteries, plus spares. 1 - disc battery for RAM card.
Environmental case:	Optional for Hewlett Packard.

Hand held PC hardware minimum specifications

- 1) The available display screen must be at least 16 lines by 40 characters wide.
- 2) The operation system must be 100% DOS compatible (DOS version 3.0 minimum).
- 3) There must be at least one standard serial port available.
- 4) There must be at least 300K system RAM available, and at least 512K of disk space available.

In operation, CEFB requires approximately 300K of system RAM. Since dynamic memory allocation techniques were used extensively in development, it is suggested that a minimum of 100K of additional system RAM be made available for normal operation. It is also recommended that all Ramcards be of the Electronic Disk type (battery powered). This insures safe data storage due to power failure.

Getting Started with a Hewlett Packard Hand held

Hardware recommended for data collection

- 1 - Hewlett Packard 95, 100, or 200 PC Computer
- 2 - Size AA alkaline batteries, plus spares
- 1 - disc battery
- 1 - TDS cable from the HP95 to the total station (same as HP48 TDS cable)
- 1 - Cable from the HP95 to the Main PC
- 1 - Electronic Disk (Ramcard) - Minimum 512 KB
- 1 - Environmental case for HP's (optional)

Configuring the system

Start at the HP Main Menu. This is the menu containing the date and time on the first line, and the *Press a blue application key...* on the bottom line. If you are in another application, exit this application using the quit function. If quit is not shown on either of the top two lines, press the <menu> key just below the <Enter> key, then either press **Q** to quit, or highlight the quit function using the arrow keys and press <Enter>.

Enter the system configuration menu. To do this, hold down the <Shift> key and press the <setup> key. The shift key is the bottom left key with a brownish up-arrow on the top. The setup key is just below the <Esc> key. The following keystroke will set the system memory required on the Hand held.

KEYSTROKE	RESULT
S	Enters the system configuration menu.
M	Activates the memory allocation function.
--	Toggle right or left to adjust RAM disk to System RAM ratio. system RAM should be a minimum of 438. If you did not change the memory allocation values, press Q to quit and skip the next two steps.
<Enter>	Window pops-up: <i>Reboot of the system needed...</i>
<Enter>	Reboots the system, you are done.

If you would like to edit the date or time, enter the configuration menu again. Rather than pressing **M** for memory, press either **T** for time or **D** for Date.

Setting up a directory for CEFB

The hard drive or the ram card can be used for the working directory for CEFB. Both are equally suitable. The ram card, however, is recommended because of the separate battery in the ram card which will prevent data loss in the main and backup battery runs out. The following are steps to get to the dos prompt in the HP Hand held and setup a CEFB working directory. If you are using the ram card for your working directory, there is no need to create a CEFB directory. The ram card is your working directory.

From the "MAIN MENU" press the blue application key **FILER**. The keys at the bottom of the screen are for deleting, copying, moving, running programs, etc. Press the **MENU** key (third key to the right of the space bar). This brings up a menu at the top of the screen which allows you to sort files, create/delete directories, exit to DOS, etc. At this point there are two methods for creating a your working CEFB subdirectory on the hard drive.

- 1) Press **s**. You are now at the DOS prompt. Type 'md cefb', to make a subdirectory called CEFB. Now type "exit" and press the **ENTER** key and any other key to return to the filer.
- 2) Press **d**. "Create" is highlighted so press **ENTER**. Curser over to the right of the back slash using your arrow right key and type "cefb". You have just created a subdirectory "CEFB" and it should be displayed under the root directory C.

At the top of the screen, centered just above the double line, you will see "NoDirs". You can change this to "Dirs" by pressing the **MENU** key then pressing **o** for "Options" then pressing **d** for "Dirs" and selecting "Yes". When it is changed to "Dirs" you can use the **F3** key located in the bottom menu to delete directories and files within them. This information is included only if you wish to remove a directory and its files. Be warned that this could be dangerous as an entire directory can be easily deleted.

To get out of the upper "Menu" at any time just press **ESC** key and the lower "Menu" will be displayed. You always have to press the **MENU** key to exit an application. So, hit the **MENU** key again to bring up the menu at the top of the screen and press **q** to quit the filer. You should close each application (by hitting **q**) when you are through with it because it prolongs battery life.

Installation of CEFB

1. Copy the CEFB files to a directory on the PC.
2. Transfer each file into the CEFB directory on the HP95 using one of the data transfer methods in Appendix II.

Getting Started with a Paravant RHC-44

Hardware recommended for data collection

- 1 - RHC-44 Computer
- 2 - Battery Packs
 - 1 - Power Module (wall transformer with cable)
 - 1 - Communications and Power cable (FLX cable)
 - 1 - Null-modem adapter
- 2 - Electronic Disks (Ramcard) - Minimum 512 KB
 - 1 - Floppy disk containing PCFLX utility
- 1 - Carrying Case

Source: Paravant Dealer
1-800-848-8529

Additional items

FLX cable adapter: Serial Port Adapter, Male DB25 to Female DB9

Source: Radio Shack or any computer store

Serial communications cable from total station to Paravant RHC-44

Source: Lengemann of Florida, INC.

1-800-342-9238

Note: To minimize confusion it may be easier to describe the cable as the cable used for the Florida DOT EFB (data collector), since they are the same and Lengemann is more familiar with this name.

Battery and compartment

The battery and reset switch are located in the compartment at the bottom of the RHC-44. It takes approximately 12 hours to charge the main battery which will allow for about 10 hours of use without backlighting. It is recommended to charge the battery after each day in the field. Since there are no memory problems with this battery, it is not necessary to completely discharge it before charging.

Charging the battery

- 1) The RHC-44 has a built in battery charger. Connect round connector on the FLX cable which came with the package to the bayonet connector on the top of the RHC-44. There is usually a small dot on the connector that faces upward.
- 2) On the opposite end of the FLX cable is a somewhat square DB-25 connector which has a small round power source outlet on one side. Connect the small end of the wall transformer here, and then plug the transformer into any standard outlet. The RHC-44 will make a small beep to indicate charging. While charging the RHC-44 may be used.

Turning on the RHC-44

- 1) Note that the second row of keys from the top of the RHC-44 reads:
SHIFT CTRL ALT FUNCT POWER ESC TAB
- 2) Hold the FUNCT key down and press the POWER key to turn on the RHC-44. If this does not work the battery maybe low.
- 3) Repeat the above key strokes to turn the RHC-44 off.

Formatting the Ramcard

An Electronic Disk (Ramcard) must be formatted before data can be stored on it. Formatting must also be done after the RHC-44 has been in storage or if the battery in the Ramcard has failed.

Note: Formatting will destroy all data on a Ramcard prior to the formatting process.

- 1) Make sure that the Ramcard is in the 'A' drive, which is located in the battery compartment. If there is no Ramcard in the drive, insert one so that the label is towards the back of the RHC-44 and then replace the compartment cover.
- 2) Turn the RHC-44 On.
- 3) The following command must be typed from the 'C' drive. The line on the RHC-44 should read c:\>, if it reads a:\> or b:\>, type C: and then press the <Enter> key.
- 4) Type: FORMAT A: <Enter>.

Configuring the system

- 1) Type CONFIG and then press <Enter>. The RHC-44 Main Menu will appear.
- 2) Press the <F2> key. The *LOW POWER/EVENT WAIT CONFIG.* screen will appear. This will effect the life of the battery between charges.

KEYSTROKE	RESULT
<Enter> 05	Moves the cursor to the <i>Automatic Power Down</i> Timeout line. This will instruct the computer to power down after 5 minutes of non-use. Note: When power down occurs it will not move you out of CEFB.
<Enter>	Accepts 5 minutes and moves the cursor to the * <i>Activate</i> line. Use the right or left arrows to choose <i>Yes</i> .
<Enter>	Accepts <i>Yes</i> and moves the cursor to the * <i>Location</i> line. Use the right or left arrows to choose <i>DOS</i> .
<Enter>	Accepts <i>DOS</i> and moves the cursor to the <i>Enable Serial Port?</i> Use arrows to choose <i>Yes</i> .
<Enter>	Accepts <i>Yes</i> and moves the cursor to <i>Install Low Power Handler?</i> Use arrows to choose <i>Yes</i> .
<Enter> 30	Accepts <i>Yes</i> and moves the cursor to the <i>Low Power Message</i> interval. Sets the Low Power Message to 32 seconds. When any of the batteries are nearly dead, a message will appear and repeat after 32 seconds, then 16, 8, and finally 4.
<Enter>	Accepts 30 seconds.
<Esc> Y	Prompts <i>Save Changes ?</i> in center of screen. <i>Yes</i>
<Enter>	Accepts <i>Yes</i> and exits back to the Config Main Menu.

- 3) Setting the real time clock. This clock uses a crystal time base which maintains the time and date separate from the main battery. The clock must be reset after storage and after a hard reset. When setting the clock, set the seconds an adequate time ahead so that the <Enter> key can be pressed at the proper time.

KEYSTROKE	RESULT
<F4>	Activates the Real Time Clock Screen. Note: the time is in 24 hour format, two digits must be input for each the <i>Hour:Minute:Second</i> . For example: 01:30:00 would be 1:30 am, & 22:30:00 would be 10:30 pm.
hh	This replaces the two digits for the hour highlighted below the existing time and then highlights the minutes.
mm	Replaces the two digits for the minute highlighted below the existing time and highlights the seconds.
ss	Replaces the two digits for the seconds highlighted below the existing time and activates a prompt.
<Enter>	Activates the time as keyed in. If an error has been made merely use the <Enter> key to toggle between TIME and DATE, and re-enter the correct digits.

The DATE format is *MM:DD:YYYY* and is entered similar to the TIME. The region to be edited is highlighted below the existing date and must be retyped. When the digits are all entered a prompt will appear. Press the <Enter> key to accept.

When the TIME and DATE are entered satisfactory, press the <Esc> key to exit the Real Time Clock Display. The configuration routines that we needed to accomplish are finished. To save the configuration and answer the additional DOS prompts, follow the remaining keystrokes.

KEYSTROKE	RESULT
<Esc>	A prompt appears: "Set New Configuration?"
Y	Tells routine Yes.
<Enter>	Accepts configuration and DOS prompts: " <i>Enter new date (mm-dd-yy):</i> ".
mm	Enters two digits for the month.
SHIFT ,	Places a hyphen between the month and day. To activate, hold down the SHIFT key and press the "," (comma) key located in the second row from the bottom, two key to the left of the ENTER key.
dd	Enters two digits for the day.
SHIFT ,	Places a hyphen between the day and the year.
yy	Enters the last two digits of the year. DOS will prompt for TIME input. DOS TIME and DATE do not know that the Real TIME and DATE exist (as previously set in CONFIG). CEFB utilizes DOS TIME and DATE and therefore they must also be set.

KEYSTROKE	RESULT
hh	Enters two digits for the hour. Note: DOS TIME is also in 24 hour format.
:	Places a colon between the hour and minute. The "COLON" key is located on the bottom row to the left of the SPACE bar.
mm	Enters two digits for the minutes.
:	Places a colon between the minutes and seconds.
ss	Enters two digits for the seconds.
<Enter>	Accepts the time and returns to the C-prompt, C>.

Installation of CEFB

There is no INSTALL program for the CEFB software. A file transfer program provided with the Paravant will be used between the computer and the RHC-44. First a copy of CEFB will be placed on the hard drive in your computer and then a copy will be transferred to the Paravant RHC-44 for field use.

You will need to log to the root directory where you wish to store your CEFB files on the computer, e.g. c:\.

- 1) Make a directory called CEFB on the same drive that CMM has been installed.

To do this: log to the drive that contains CMM and type *MD CEFB* and press <Enter>.

- 2) Place the disk containing the CEFB files in the appropriate disk drive (A or B). In order to copy the files from your disk to your CEFB directory in your computer type the following: *copy (disk drive):\cefb.* (computer drive):\cefb.*

For example if your disk is in the A: drive, and your CEFB directory is in the C: drive (i.e. C:\CEFB), you would type: *copy a:\cefb.* c:\cefb.* Notice there is a space after **copy** and another after the asterisk (*).

Type: *copy (disk drive):*.con (computer drive):\cefb*

Type: *copy (disk drive):*.ep (computer drive):\cefb*

The following is a list of files that should exist within your CEFB directory. To view them, log to the CEFB directory from your root directory by typing *cd cefb* <Enter>. Now type *DIR*.

CEFB.EXE CEFB.CF CEFB.IND CEFB.FC NAD27.CON NAD83.CON <Year>.EP

- 3) In order to transfer CEFB to the Paravant you need to install the PCFLX program to your hard drive. It is probably best to place PCFLX in the CMM directory. To do this place the disk included with the Paravant in the appropriate disk drive and type: *copy (disk drive):\pcflx.exe (computer drive):\cmm.* This is similar to the command in step 2.
- 4) Now transfer the CEFB files to the Paravant RHC-44. To do this we will utilize two file transfer programs. One is PCFLX, located in the CMM directory of your hard drive. The other is RHCFLX located in the C: drive of the RHC-44.
 - a. Take the FLX cable and the null-modem adapter that were included with the RHC-44 and connect them. If the COM1 port on your computer is a typical DB-25 connector you may connect these ports. However, if the COM1 port is a DB-9 connector attach the serial port adapter (Female DB-9 to Female DB-25) to the null-modem and then connect to the COM1 port.
 - b. Connect the adapter end of the cable to the COM1 port at the back of your computer. If you are using a mouse you will most likely have to disconnect it.
 - c. Connect the round end of the FLX cable to the bayonet connector on the top of the RHC-44.
 - d. Turn on the RHC-44 and log onto the C: drive. Type: *C: <Enter>*
 - e. Type: *RHCFLX <Enter>* A message "Awaiting Commands" will appear flashing.
 - f. From the CMM directory on your computer type: *PCFLX <Enter>.*
 - g. Configure Port Press **1**
 - h. RS-232 Port 1 (Com1) Press **1**
 - i. Valid baud rate, toggle with arrow keys to **9600** and press <Enter>.
 - j. Send file Press **2**
 - k. Include with overwrite options? Press **Y**
 - l. Enter filename including path - type: *(computer drive):\cefb*.* <Enter>*
 - m. Enter file destination path - type: *A:\ <Enter>*
 - n. Accept this command (Y/N)? Press **Y**

When both computer screens read File Transfer 100% complete you may exit both file transfer programs. For the RHC-44 press the <Esc> key, on the PC press 4 - Exit program. The cables may now be disconnected.

File Processing Programs

The CEFB file processing programs should be copied to the CMM directory. Their use will be explained in detail later.

To do this place your disk in the appropriate drive and type: *copy (drive):!*.* (drive):cmm*

For example if your disk is in the a: drive and the cmm directory is on C: drive type: *copy a:!*.* C:cmm.*

File Processing programs:

FFTOOBS.EXE	TOLSA.EXE	ASTRO.EXE	CODESORT.EXE
OBS2NOTE.EXE	PRELEV.EXE	LEVEL.EXE	

If the post processing files were included on the same disk, the CEFB.EXE file may also exist in the list above. You can delete it if you wish.

Cadastral Measurement Management - Installation

CMM software is distributed on 2 - 1.4MB 3.5" diskettes. CMM requires an IBM compatible PC with a full 640 K base RAM, a hard disk with at least 3 MB free space. A math coprocessor is required. An 286, 386, 486 or pentium coprocessor with an EGA or VGA compatible graphics card and monitor, is preferred.

Note: If you have your own text compatible (ASCII) editor that you would prefer to use with the system, the install process requires that you know it's directory path and name.

The CMM Install process utilizes the drive you are installing from and the drive and path you are installing to. It creates the directory that CMM will be stored in and then creates and runs a batch file that manages installation of the system files and programs. The files are contained in compressed archive format on the installation disk and cannot be run from the floppy, or merely copied to a hard disc and run.

If you do not have sufficient room on the target drive, the installation may appear to be complete, but files not fitting will not have been installed. Please be sure you have sufficient space on your disk before proceeding with the installation. To check merely turn the computer on and log to the drive that CMM is to be installed. For instance type the letter of the drive (C, D, or E) and :, then press <Enter>. Now type *DIR* and then <Enter>. The number just before "bytes free" must be greater than 3,000,000. If it is not you must either choose another drive or make room on that drive.

When the file installation process is complete (whether or not successfully) the installation resumes by allowing you to specify your own preferred editor or an <Enter> will select the default Public Domain editor provided.

The final act of the complete installation process is to create 2 DOS batch files in the root directory of your C: drive. The first of these is critical to the operation of CMM and it is called CMM.BAT. This batch file is the access method to the CMM system and handles CMM's main menu operations. The second batch file created is called GMM.BAT, and it's sole purpose is to allow you to quickly move to the selected CMM drive and directory at the DOS level if you choose.

The second option in the install program can also be used to make a new CMM.BAT whenever necessary, if for example, you move your CMM files to a different drive, directory OR you want to change the default editor choice.

Install Steps

- 1) Place the CMM release diskette #1 in either drive A or B as appropriate for you system. For the multi disk sets, be sure you inserted disk 1.
- 2) Log to that drive, for example if drive A: Type: *a:* <Enter>
- 3) then type: *install* <Enter>
- 4) follow the prompts, and the process is rather straightforward.

Note: If you have previously installed CMM in the same directory you will be prompted to verify overwriting each file that is installed. Use you judgement about whether this is appropriate or not and answer Y or N accordingly. The install will skip over files that are the same or of later date, so there is no risk of overwriting a later version of a file.

- 5) After the program exits, you should be able to invoke the system by typing: *CMM* <Enter>.

The following is a list of files that should exist within your CMM directory:

ADJUST.EXE	AUTOPROP.EXE	BLUNDER.EXE	CHECKER.EXE
CMOVE.EXE	COMBIN.EXE	COMPAR.EXE	CONVERT.EXE
CSTUF.EXE	CSTUF.HLP	CURVE.EXE	CURVE.INF
DXFLSA.EXE	GENER.EXE	GJA.EXE	INREC.EXE
JOBMAN.EXE	LHA.EXE	LHA.HLP	LIETZ.EXE
LOOK.EXE	LOOPER.EXE	LS286.EXE	LS386.EXE
LSAQ.EXE	MAIN.EXE	MODERN.FON	NAD27.CON
NAD83.CON	PROJEC.EXE	PROPORT.EXE	RAW.EXE
READCMM.TXT	SD.EXE	SECTSHOW.EXE	SETUP.EXE
SJA.EXE	SSHOT.EXE	TABLE.DAT	TDSLSA.EXE
TE.EXE	UTCOMM.EXE	UTCOMM.PRG	UTM.EXE
VIEW.EXE	WHATIS.EXE	ZONE.DAT	

Software

The following are brief descriptions of files and programs required for CEFB & CMM use on the Hand held and PC. Some programs and files will be discussed in detail later in Chapter 4.

On the Hand held data collector

CEFB.EXE

The CEFB executable itself. This can be run on your PC for manual testing, experimentation and learning, however, normally it will be running on the hand held computer. Running this will allow you to create project data files and a CEFB configuration (.cf) file. In order for CEFB to be fully functional, the following support files are usually required on the hand held computer.

<1997>.EP

This is the Solar and Polaris ephemeris (.ep) file for 1997 where <1997> is the current year. Other stars in the menu are not automatically available.

<CEFB>.FC

This is the 'feature code' (.fc) file where <CEFB> can be any legal DOS file name. This is a user defined file defining the descriptive macros surveyors want to execute in the field to describe encountered features. These macros are similar in concept to WordPerfect macros.

Feature codes provide a tremendous amount of flexibility but require user creativity to utilized its full potential. There are five kinds of prompts of functions within a feature code. The best way to learn about the syntax of feature codes is to study a feature code (.fc) file and execute some on your PC. Also note the index and feature code file support program CODESORT.

<CEFB>.IND

This is the 'index' (.ind) file where <CEFB> can be any legal DOS file name. This is a user defined file defining the features surveyors anticipated collecting in the field with the features associated prefixes and counter for automatic point indexing. The best way to learn about the syntax of feature codes is to study a feature code (.fc) file and execute some on your PC. Also note the index and feature code (.fc) file support program CODESORT.

NAD27.CON

This file contains the state plane coordinate system zone constants for NAD27.

NAD83.CON

This file contains the state plane coordinate system zone constants for NAD83.

On the office PC

File transfer software

Since most of the smaller hand held computers do not have floppy disk drives, data and program files must be sent to/from the hand held computer via cable communication using the serial port.

The Hewlett Packard hand held computer includes communication packages (connectivity pack) used with the Filer (blue key) to support file transfers to the PC. This software is very similar to Lap Link. The connectivity pack includes the cable to the PC and software for about \$95.

There are several alternative communication software packages that can be used to transfer files from the hand held computers to the PC. Some common communication packages are ProComm, ProComm Plus, Softerm, or Kermit PC. Appendix II contains documentation on using ProComm Plus and the HP connectivity pack for transferring files from the HP handheld's to the PC.

The Paravant communications package contains the RHCFLX program on the hand held computer and the PCFLX program on the PC. These programs should be executed simultaneously after cables have been correctly inserted. This software performs similar to Lap Link. The Paravant communication package is the only available option for the Paravant hand held computer.

CODESORT.EXE

This program is designed to aid users who customizes the feature code (.fc) and index (.ind) files. The program checks the files syntax and points any errors out to the user, the program then sort the two files alphabetically to the pick list functionality in CEFB.

FFTOOBS.EXE

Converts the binary field (.ff) file into a readable formatted observation (.obs) file. FFTOBS does no actual observation reductions. This program provides the rough equivalent of a field book and along with the field (.ff) file should be kept and possibly printed out as traceable evidence of the survey data.

Common practice may require some slight editing of the observation (.obs) file with an ASCII editor to tag some records as 'deleted' or fix point naming problems or other mistakes you may have made in the field. The original unaltered field data still lies in the field (.ff) file.

ASTRO.EXE

A standalone astronomic observation processing program. This program will read a specified observation (.obs) file and allow the user to reduce survey observation data to an astronomic azimuth. The azimuth computations are based on user defined quantities for GHA, declination, semi-diameter, leading/center/trailing edge, etc.

TOLSA.EXE

Processes the observations in the observation (.obs) file and reduces all repetitions to mean observations for angles, distances, and azimuths. It will also process any imbedded Solar or Polaris observations. TOLSA then adds the reduced data to the project.LSA file for CMM analysis. TOLSA creates .LSA (mean observation), .SSS (sideshot), .SD (error estimates), and .ZZZ (elevation differences) data files. TOLSA also creates a project.REP file which contains repetition errors and a variety of other information related to the processing of the observation (.obs) file. TOLSA also backs up any existing .LSA, .SSS, .SD, and .ZZZ files to .LSB, .SSB, .SDB, and .ZZB files to prevent accidental destruction of important data.

CHAPTER TWO - CEFB - Basics

Transfer of data from CEFB to CMM

Survey data collected with CEFB is stored in a binary field (.ff) file. This binary file can **not** be viewed, or edited using a text editor (i.e. DOS Editor, Norton Editor, PCTOOLS), or read by CMM. First, the field file must be converted to a user readable ASCII observation (.obs) file. Once this step is complete, the observation (.obs) file is then converted to a CMM readable file least square adjustment (.lsa) file..

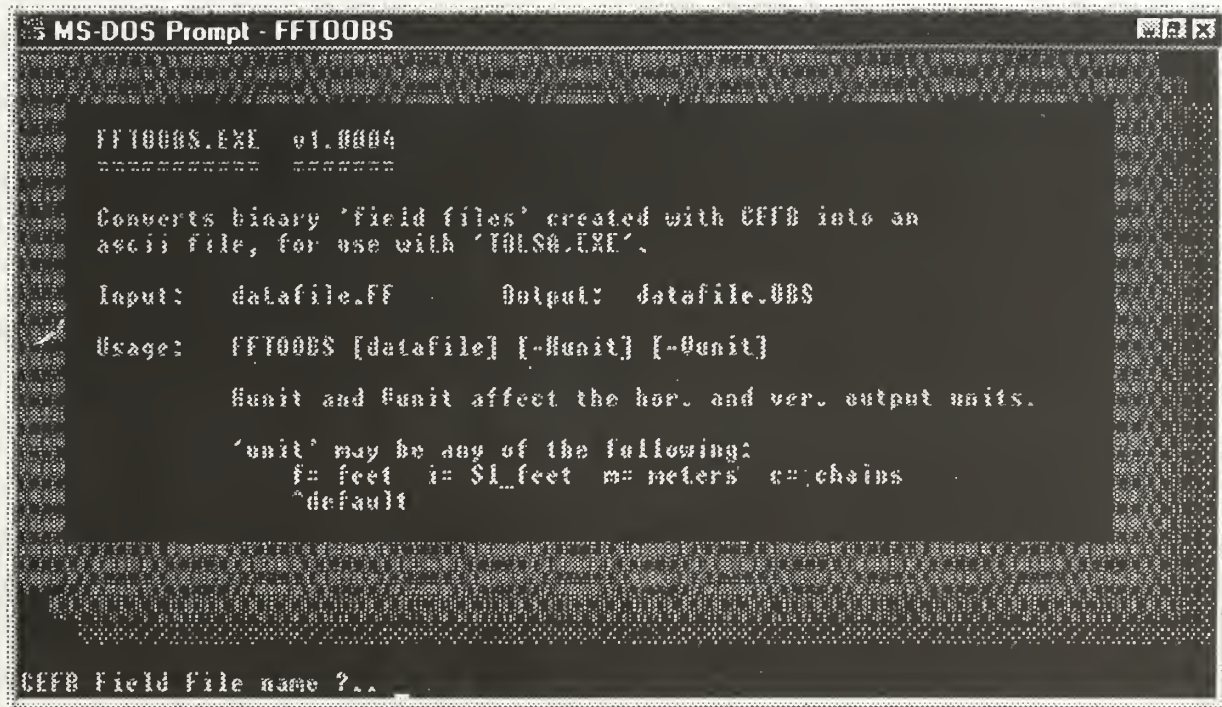
The field (.ff) file must first be transferred from the field machine to the PC. This can be accomplished through use of any available file transfer system designed for your particular field machine. For example, Paravant has it's own file transfer system called PCFLX and Hewlett Packard has the Connectivity Pack. Please see the appropriate section in this reference guide for your specific transfer system.

Once the field file transfer to the PC is complete, two steps must be performed to convert the field file into a file which CMM can utilize (*project.LSA*).

1. First, a binary to ASCII conversion must be performed using the FFTOOLS.EXE program. This program creates an observation (.obs) file which may be viewed and/or edited with any text editor. Before continuing to the next step, survey observations may be reviewed and/or edited.
2. A least square adjustment (.lsa) file must then be created for CMM to perform a **Least Squares Adjustment**. The TOLSA.EXE program is used to convert the observation (.obs) file into a least squares adjustment (.lsa) file.

Step #1: FFTOOLS.EXE - Binary to ASCII Conversion

The FFTOOLS.EXE program is used to convert a binary field (.ff) file into an ASCII observation (.obs) file. Most likely the field (.ff) file and the FFTOOLS.EXE program will both exist within the CMM directory on the PC. To run FFTOOLS.EXE, simply type: **FFTOOLS** and press <Enter>. Figure 2.1 Displays the initial screen of FFTOOLS.



```
MS-DOS Prompt - FFTOBS

FFTOBS.EXE  v1.0004
*****

Converts binary 'field files' created with CEFB into an
ascii file, for use with 'TOLSO.EXE'.

Input:  datafile.FF      Output:  datafile.OBS

Usage:  FFTOBS [datafile] [-Hunit] [-Vunit]

      Hunit and Vunit affect the hor. and ver. output units.

      'unit' may be any of the following:
      f= feet  i= SI_feet  m= meters  c= chains
      ^default

CEFB Field File name ?..
```

Figure 2.1: FFTOBS Screen

From this prompt the user can input the field (.ff) file without the .FF extension along with the Horizontal and Vertical parameters if desired. The screen will display the number of records processing and return the user to the dos prompt when completed. If an error while occurs processing records, the user will be notified and returned to the dos prompt.

The Horizontal and Vertical parameters allows users to convert the between desired horizontal and vertical units between the field and observation (.obs) files. The correct syntax for these parameters are -H and -V immediately followed the character defining the desired unit. The following are FFTOBS examples using the meters and chains for horizontal and vertical parameters respectively:

```
FFTOBS [field file name] -Hm -Vm
FFTOBS [field file name] -Hc -Vc
```

If unit conversion is not desired in FFTOBS, simply do not include any horizontal or vertical parameters in the command. To run FFTOBS.EXE, bypassing the initial prompt type:

FFTOBS [field file name] [-H(unit desired)] [-V(unit desired)] and press <Enter>.

Notes: * Do not include the square brackets around the filename as shown.

* It is not necessary to include the .FF extension when typing the field filename.

* The output file will have the same file name with the .OBS extension. This file may now be reviewed or edited.

* If you type: FFTOOBS and press <Enter> without including the field (.ff) file name, the FFTOOBS program will ask, "*CEFB Field File Name?..*". To respond, just type the file name and press <Enter> .

If your FFTOOBS.EXE program is not in the same directory as the desired field (.ff) file, include the path before the field file name.

Type: **FFTOOBS** [path\filename] <Enter>

example: FFTOOBS c:\CMM\filename

Note: The output file will be created in the same directory that contains the field (.ff) file.

Observation File (.OBS)

The observation (.obs) file is the ASCII file containing all of the raw field observations and descriptions. A typical observation (.obs) file is shown in Table 2.1. The highlighted areas are for demonstration purposes only.

COLUMNS												
		10	20	30	40	50	60	70	80	90		
		123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	12..	
1	R	CEFB	v1.0003									
2	S	001	002	5.500						Fri May 11 07:41:53 1997		
3	B	0	0	0.0								
4	F	003	2	5.000	177 16 45.0	92 14 55.0	870.246		0.000	Fri May 11 07:42:10 1997		
5	B	0	0	0.0								
R 6	F	003	2	5.000	177 16 43.0	267 45 15.0	870.246		0.000	Fri May 11 07:43:12 1997		
O 7	F	SS01	2	5.000	21 15 25.0	272 08 10.0	145.630		0.000	Fri May 11 07:43:57 1997		
W 8	FD	SS02	2	5.000	143 59 47.0	267 59 55.0	225.050		0.000	Fri May 1 07:44:57 1997		
S 9	R	SS01	Found granite stone, 4 in. x 4 in., protruding 2.5 in above grade									
10	R	002	PK set on the east edge of Mondell Rd at U.P. #22603									
11	S	002	003	5.500								
12	B	0	0	0.0								
13	FU	SS04	2	5.000	227 46 50.0	89 58 5.0	1047.366		0.000	Fri May 11 07:45:40 1997		
14	FM	SS03	2	5.000	227 46 50.0	89 58 5.0	1047.366		0.000	Fri May 11 07:46:30 1997		
16	C			11	0	0.0	90	0	0.0	Fri May 09 13:58:02 1997		

Table 2.1: Observation File

(.OBS) - Record Types

Column #1 of the observation (.obs) file in Table 2.1 identifies the type of record contained on the corresponding row (line). Only one record will occupy any line within the observation (.obs) file. The type of record is identified by the associated record identifier. There are six different types of records contained within an observation (.obs) file. These are defined in Table 2.2, and examples, if they exist, are referenced to Table 2.1.

Record Type	Identifier	Example Row	Example Column
1. Remark	R	1	1
2. Instrument Setup	S	2	1
3. Back sight	B	3	1
4. Foresight	F	4	1
5. Astronomic Data	D	none	none
6. Calibration	C	none	none

Table 2.2: Observation File Record Type

Record Format in (.OBS) File

The use of columns beyond the second column varies among record types. The following tables define the information contained within each record.

Data Description	Beginning Column	Ending Column
Record Identifier (R)	1	1
Flag	2	2
Station Name	4	11
Alpha-numeric text	13	END

Table 2.3: Remark Record Format

```

10      20      30      40      50      60      70      80      90
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12...
R  SS01      Found granite stone, 4 in. x 4 in., protruding 2.5 in above grade

```

Data Description	Beginning Column	Ending Column
Record Identifier (S)	1	1
Flag	2	2
Back sighted Station	5	12
Occupied Station	14	21
Height of Instrument (ft)	24	28
Date & Time Tag	69	92

Table 2.4: Setup Record Format

10 20 30 40 50 60 70 80 90
 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12...
 S 001 002 5.500 Fri May 11 07:41:53 1997

Data Description	Beginning Column	Ending Column
Record Identifier (B)	1	1
Flag	2	2
Back sight Angle (dms)	6	15

Table 2.5: Back sight Record Format

10 20 30 40 50 60 70 80 90
 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12...
 B 0 0 0.0

Data Description	Beginning Column	Ending Column
Record Identifier (F)	1	1
Flag	2	2
Foresighted Station	5	12
Observation Mode	14	14
Height of Prism (ft)	16	21
Horizontal Angle (dms)	23	33
Zenith Angle (dms)	35	45
Slope Distance (ft)	50	55
Eccentric Direction	57	57
Eccentric Distance (ft)	59	67
Date & Time Tag	69	92

Table 2.6: Foresight Record Format

10 20 30 40 50 60 70 80 90
 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12...
 F 003 2 5.000 177 16 45.0 92 14 55.0 870.246 0.000 Fri May 11 07:42:10 1997

Data Description	Beginning Column	Ending Column
Record Identifier [Ⓢ]	1	1
Flag	2	2
Horizontal Plate (dms)	23	33
Vertical Plate (dms)	35	45
Date & Time Tag	69	92

Table 2.7: Calibration Record Format

```

10      20      30      40      50      60      70      80      90
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12...
C          11 0 0.0 90 0 0.0                               Fri May 09 13:58:02 1997

```

Data Description	Beginning Column	Ending Column
Record Identifier (D)	1	1
Flag	2	2
GHA 0 hr (ddd.mmssss)	5	14
GHA 24 hr (ddd.mmssss)	17	27
Declination 0 hr (ddd.mmssss)	29	39
Declination 24 hr (ddd.mmssss)	43	51
Semidiameter 0 hr (ddd.mmssss)	54	63
Semidiameter 24 hr (ddd.mmssss)	66	75
Sighted Edge (T, C, or L)	77	77
Time zone Correction (hrs)	80	81
Clock Offset (dd mm ss.ss)	85	94
Latitude (ddd.mmssss)	96	106
Longitude (ddd.mmssss)	108	118

Table 2.8: Astronomic Data Record Format

10 20 30 40 50 60 70 80 90 100 110
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789
D 180 53 23.9 180 54 2.9 17 18 26.7 17 34 20.8 0 15 50.5 0 15 50.3 T 0 0 0 0.0 45 28 31.6 68 9 15.9

Observation (.obs) File - Observation Status

Column #2 of the observation (.obs) file identifies the status of the corresponding record with one of four flags. These flags are shown in Table 2.9, and referenced to Table 2.1.

Record Status	Flag	Example Row	Example Column
1. Unedited	' '	2	2
2. Deleted	D	8	2
3. Modified	M	14	2
4. Undeleted	U	15	2

Table 2.9: (.OBS) Status Flags

Notes: * A record which contains no flag (' ') in the second column is an unedited record. This means the record is original, and was not edited in the field.

* A record flagged with a 'D' indicates that the record was deleted. All records flagged with a 'D' will be automatically ignored by the TOLSA.EXE program used in the next step.

* A record flagged with a 'U' indicates that the record was deleted and then undeleted. This record will be treated as original by TOLSA.EXE.

* A record flagged with an 'M' has been modified. The new record will appear directly below the modified record, and this new record will be used by the TOLSA.EXE program.

Step #2 TOLSA.EXE

Processes the observations in the observation (.obs) file and reduces all repetitions to mean observations for angles, distances, and azimuths. It will also process any imbedded solar or polaris observations. TOLSA then adds the reduced data to a least square adjustment (.lsa) file for CMM analysis.

TOLSA creates .LSA (mean observation), .SSS (sideshot), .SD (error estimates), and .ZZZ (elevation differences) data files. TOLSA also creates a job.REP file which contains repetition errors and a variety of other information related to the processing of the .OBS file. TOLSA also backs up any existing .LSA, .SSS, .SD, and .ZZZ files to .LSB, .SSB, .SDB, and .ZZB files to prevent accidental destruction of important data. Two default files are used during the execution of TOLSA to define what and how files are produced.

DEFAULT.CON

Contains two lines of information pertinent to the TOLSA and GENER programs in CMM. The first line contains two characters (in column 1 and column 2) and the second line contains five numerical values (separated by spaces). The characters on line one may be either a 'Y' or a 'N'.

If the first character on line one is a 'Y', TOLSA will compute statistical error estimates from observations in the job.OBS file into a job.SD file. If this character is 'N', no job.SD file will be created.

If the second character in the first line is a 'Y', TOLSA will compute the associated sideshot (.sss) file by looking at the connectivity between the existing least square adjustment (.lsa) and observation (.obs) files. Observations with connectivity are placed in the least square adjustment (.lsa) file, while observation without connectivity are placed in the sideshot (.sss) file. If this character is 'N', and all observational data is inserted into the least square adjustment (.lsa) file.

The five numerical values on the second line are 'constant' errors associated with the distance, distance PPM, horizontal angle (seconds), azimuth (seconds), and elevation differences respectively. If error estimates are being computed, these values will be added to the computed error estimates for a final error estimate. The constant errors are critical in estimating random error which was undetected by repetition.

DEFAULT.SD

This file contains one line with five numerical fields, separated by spaces. These numerical values correspond to 'default' error estimates for EDM distance, EDM PPM, horizontal angle (seconds), azimuth (seconds), and elevation differences respectively. These default error values are assigned to observations for which no statistical error estimate could be computed (i.e. there was only one observation in the (.obs) file, or this option is turned off).

TOLSA Execution

The first prompt in TOLSA allows the user to change the project name. This prompt is shown below.

```
COMPUTER PROGRAM TOLSA 07-19-94 (VER 0.14)
PROJECT IS TEST
DO YOU WANT TO CHANGE IT (Y/N) <N>?
```

If error estimate are being computed based on the character setting in the DEFAULT.CON file, the following statement will follow the first prompt.

```
COMPUTED STANDARD ERRORS WILL BE USED
```

The user then has the choice to define the observation (.obs) file to be read with the following prompt.

FIELD DATA WILL BE READ FROM TEST.OBS
ENTER ANOTHER FILE NAME (NO EXTENSION) OR PRESS ENTER IF OK

TOLSA will produce the corresponding (.zzz) and (.rep) files and then process the setups and/or polaris and solar observations found in the defined observation (.obs) file. The following statements will notify the user as functions are performed.

ELEVATION DIFFERENCES ARE WRITTEN TO TEST.ZZZ
PROCESSING REPORT WRITTEN TO TEST.REP

PROCESSING SETUP AT STATION 2
PROCESSING SETUP AT STATION 2
PROCESSING SETUP AT STATION 3
PROCESSING SETUP AT STATION 3
PROCESSING SETUP AT STATION 4

ORIGINAL .LSA FILE IS BACKED UP IN FILE TEST.LSB

If the sideshot (.sss) file is being computed based on the character setting in the DEFAULT.CON file, TOLSA will then analyze the connectivity of the observations and position them in there corresponding file.

ANALYZING SIDESHOTS
7 OF 7 STATIONS IDENTIFIED AS SIDESHOTS

The user is then notified the program is complete with the following statement, and return him or her to the dos prompt.

Stop - Program terminated.

Transferring Coordinates From CMM to CEFB

Any coordinates you compute with APROP, PROPORT, ADJUST or CSTUF can be transferred to CEFB for use in corner search, true line staking, or corner moves by using an obscure option in CSTUF. A <project> coordinate (.cor) file in CMM is not directly usable in CEFB since the data files in CEFB are in a binary format rather than the readable/editable ASCII files in CMM.

There is an option in CSTUF.EXE that allows users to create a CEFB ready coordinate (.cr) file directly from any <project> coordinate (.cor) file in CMM. The procedure for performing this transformation is documented in the Help facility of CSTUF (F1 key) on page 17 of the help screen. All the user must do to create a CEFB binary coordinate (.cr) file is enter CSTUF.EXE, and press the <Ctrl>-<F5> key combination. Next, the user is prompted for a file name that he or she wishes to create. The user must add the .CR extension to this file. CEFB will not recognize coordinate files with any other extension.

Once the CEFB binary coordinate (.cr) file has been created, it is only a matter of transferring this file onto the data collector and defining this file as the current coordinate file ('Open coor. file'). It is always a good idea to list a couple of coordinates in COGO just to make sure that there were no problems during the data transfer process.

Coordinates "on-the-fly" in survey mode

One should consider field generated coordinates as volatile as they have not been subject to rigid analysis. In survey mode coordinates are never overwritten unless you specifically use the overwrite option. As an example the initial coordinates of 1 remain the same no matter how many times 1 is measured to in HVD mode. Every time 1 is measured to from an occupied and back sighted station with coordinates you will get a N,E,Z closure error!

Survey mode only generates coordinates if the occupied and back sighted stations have coordinates. No resection or link traverse rotation exists. Thus if you want to carry coordinates make sure the starting occupied and back sight stations have coordinates.

Binary CEFB coordinate (.cr) files can also be produced in the CSTUF program with the Binary Cor. File function previously described.

CEFB Files

The **Field File** has a .FF extension. The field file is binary and contains any and all observations and descriptions taken with CEFB. This file once in the office is converted to a ASCII observation (.obs) file by running program FFTOBS (.FF to .OBS conversion).

The **Coordinate File** has a .CR extension. It is a binary file which contains all collected and manipulated coordinates in CEFB.

The **Feature Code File** has a .FC extension. It is an ASCII file which allows surveyors to create macro descriptions of features described in the field.

The **Index File** has an .IND extension. It is an ASCII file which allows surveyors to define a prefix to be associated with a feature code, and automatically index the collection of that prefix.

NAD27.CON and **NAD83.CON** are required for automatic grid/ground calculations..

1997.EP (YEAR.EP) is the ephemeris file for 1997 required for automatic reduction of solar or polaris shots in the field.

CEFB Interface Concepts

You can access CEFB options through pull-down menus or hot keys. All hot key options are in the pull-downs, but not all pull-down options are hot keys. The most commonly selected options are hot keys.

Most of the hot keys are listed at the bottom of the CEFB screen. The capital letter in the command indicates what the hot key is.

Examples are:

Poll - P means poll the instrument (measure).
remK - K means add a remark.

Hot keys differ depending what module you are in. To access the pull-downs you can hit enter, the letter **M**, or ALT and the letter for the pull-downs. You can move left or right across the pull-downs with the left/right arrow keys. The up/down arrows allows you to select an option in a pull-down. In a pull-down a blinking letter allows you to select that option by hitting that letter on the keyboard instead of using the up/down arrows. Associated hot keys for function in pull-downs menus are shown in parenthesis if they exist.

The default for all prompts, except the Save Data prompt, in CEFB are now **No** or **Abort** for no action. This forces surveyors to select keys other than the enter key to perform certain functions, and prevents surveyors from executing functions that might not have been desired.

The top line of pick lists in which surveyors can escape out of with the ESC key are displayed as `ESC=NONE`. This to notify the surveyor that ESC key is a possible option.

Pick lists also have the character hot key functionality in which the surveyor can enter in a desire character , for example 'R', and the highlighted bar will move down to the first selection with an 'R' in the first character. This procedure can be repeated as many times as desired for consecutive characters in the selections. This at time can be a much faster method at arriving at a selection instead of scrolling down through the list.

All station ID prompts in CEFB are now limited to eight characters which Matches the character string limit of station ID's in CEFB. This was done to eliminate confusion of truncation of station ID's longer than eight characters entered in station ID prompts.

CEFB Modules

Main Module - Global options such as file names, datums, and defaults are defined. This module will be detailed in Chapter Three.

Survey Module - Survey data is observed and collected. This module will be detailed in Chapter Four.

Astronomy Module - Solar or polaris data is observed and collected. This module will be detailed in Chapter Five.

Cogo Module - Geodetic coordinate geometry system which allows surveyors to perform basic cogo functions with CEFB coordinates. This module will be detailed in Chapter Six.

Trueline Module - Produces information about where you are relative to a defined line (Trueline) which is very useful in retracing - where you are relative to a boundary line and where you are relative to the end of that boundary line. Also produces stakeout information for a desired station ID. This module will be detailed in Chapter Seven.

Read/Edit Module - Review survey measurements, point feature codes, and point descriptions. Edit survey measurements in a delete/modify mode. This module will be detailed in Chapter Eight.

Starting CEFB

Paravant

1. To start CEFB from the Paravant, log to the a: drive by typing *a:* and press <Enter>.
2. If the CEFB files were installed into a directory, change to that directory by typing *cd directory_name* and press <Enter>.
3. To activate the program type: *CEFB* and press <Enter>.

Hewlett Packard

There are two methods of invoking the CEFB program on the Hewlett Packard's palmtops. One is from the filer and the other is from the dos prompt.

Filer

1. To start CEFB from the filer, enter the Filer menu. This may be accomplished by pressing the blue key just below the <Esc> key. When activated, a menu similar to the one shown in Figure 2.2 will be displayed.

Filer	02/09/93		1:59pm	
Local	NoDirs			
C:\				
DAT	<DIR>	04-01-91	12:00a	
_CHKDSK	EXE	9680	09-05-91	8:00a
COMMAND	COM	184	09-05-91	8:00a
_CARLOAN	WK1	5232	06-05-91	8:00a
_CFLOW	WK1	4456	06-05-91	8:00a
_EXPENCE	WK1	12406	06-05-91	8:00a
_HOMEBUY	WK1	4362	06-05-91	8:00a
_STAT	WK1	5463	06-05-91	8:00a
Copy Run Remote Rename Move				
Help	Delete	Goto	Split	Tag

Figure 2.2: HP Filer Menu

2. Log to the drive which contains the CEFB files. The third line from the top in Figure 2.2 displays the current drive and directory. If you need to change drives (for example the A drive), press <F5>, and then type *a:* and press <Enter>.
3. Highlight the CEFB directory and press <Enter>. If you do not have a CEFB directory skip this step.
4. Highlight the CEFB.EXE file and press the <F4> key to activate the program.

DOS Prompt

Once in the filer menu as shown in Figure 2.2, the **MENU** key then pressing **s** for "System" will shell the user out of the filer menu to the dos prompt. The user can then launch CEFB by typing CEFB and pressing <Enter> .

Users can also boot to dos in the HP's palmtops with the Ctrl-Alt-Del keys and the following files.

Autoexec.bat

```
echo off
path=a:\;c:\
prompt $p$g
dir /w
```

Config.sys

```
SHELL=COMM
AND /P
files=32
buffers=24
```

Go.bat

```
echo off
CLS
SERCTL /W
cls
DISPCTL -C
CEFB
SERCTL /O
dispctl +c
```

M.bat

```
$sysmgr
```

Autoexec.bat and Config.sys are system files which skip over the HP's specific programs and boots directly to DOS when a soft boot is initiated with the Ctrl-Alt-Del keys. Go.bat executes CEFB with the correct screen settings, while m.bat returns the user the HP specific programs.

CHAPTER THREE - CEFB - Main Module

Main Screen

Figure 3.1 displays the initial screen of CEFB.

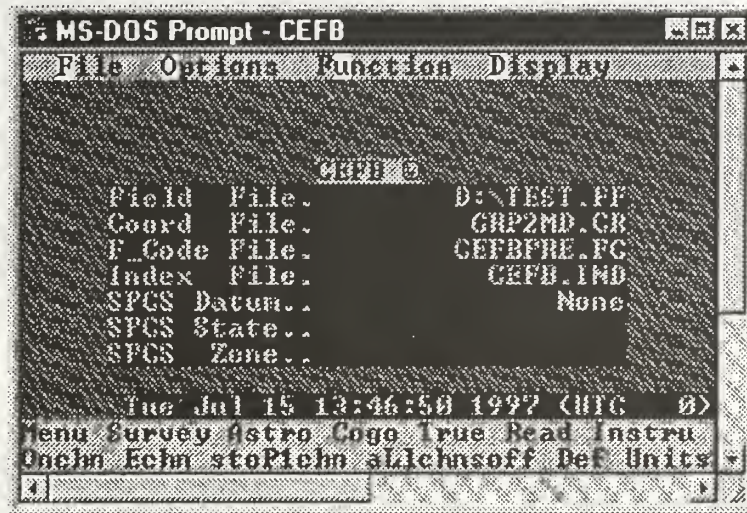


Figure 3.1: Main Module

The area in the center of the display contains information on the current files. If a file is changed by the user, it will be updated in this region.

The third line from the last contains the current system date, system time, and the time zone which is defined. The time zone is shown in two parts, the zone ID (eg. EST, Eastern Standard Time) and the hourly offset to Greenwich mean time (-5 hours).

The bottom two line contains a 'shortcut' or hot key bar which allows direct access to some operations contained in the pull-down menus above. To select a particular function directly, press the key corresponding to the capitalized letter (M, S, A, C, T, R, I, O, E, P, D, or U).

File Menu

The functions available within the File pull-down menu are shown in Figure 3.2. Before collecting data it is advised to define a field file, coord file, index file, and an Feature code file. However, only the field file is critical for the collection of data.

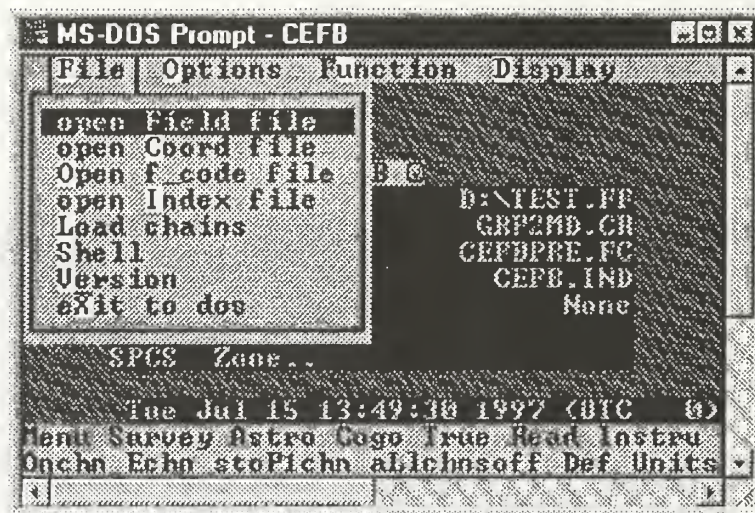


Figure 3.2: Main Module File Menu

open Field file

The 'open Field file' function will create a new file or open an existing file to store all of the observational data collected in CEFB. This field file is identified by the .FF extension and will appear in the file information area on the main screen in Figure 3.1. This and all file functions in the file pull-down menu produce a pick list of existing files with their corresponding extension in the current directory. For example, Figure 3.3 displays a typical pick list for the 'open Field file' function.

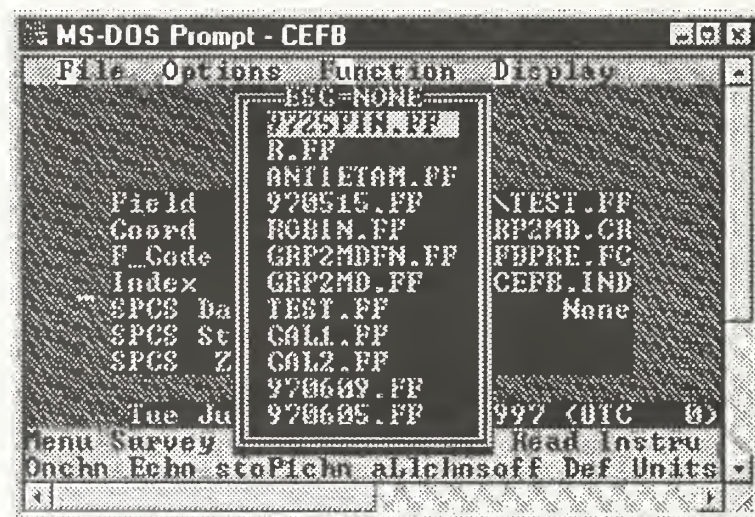


Figure 3.3: Field File Pick List

To open an existing field file simply select the desire file from the list. If the user desires to define a new field file escape the pick list with the **ESC** key as shown on the top line of the pick list. Figure 3.4 displays the following manual prompt.



Figure 3.4: Manual Field File Prompt

This prompt for the field file defaults to the current date as shown in Figure 3.4. The user may type in a new field file up to 8 characters without the .FF extension or press the <Enter> key to accept the default value.

open Coord file

The 'open Coord file' function will create a new file or open an existing file to store coordinates generated by data collection. It is identified by the .CR extension and will appear below the field file in the information area of the main screen in Figure 3.1. A method of transferring coordinate data from CMM to CEFB is detailed in Chapter Two. If no coordinate file is defined prior to data collection, CEFB will operate normally except that information and operations specific to coordinate geometry will be unavailable.

Coordinates can be defined for initial data collection by three methods. The first method is by transferring coordinate data from CMM to CEFB. The second method is by defining two sets of coordinates in CEFB in the COGO Module with the 'input' function, detailed in Chapter Six, and then begin collecting observations from those station ID's. The third method is by defining one set of coordinates in CEFB as detailed above, taking a solar observation from the defined station ID, and then collecting observations from those station ID's

It should be noted here that coordinate data in CEFB has been included only because this data is essential for certain computational aspects such as COGO. The coordinates generated by CEFB are unadjusted and should be thought of as volatile. For this reason, no utility has been made for the transfer of coordinates from CEFB to CMM.

The 'open Coord file' function produces a pick list similar to the shown in Figure 3.3, showing files with the .CR extension. If one of the existing files is not desired the ESC key will produce the following prompt shown in Figure 3.5.



Figure 3.5: Open Coord. File Manual Prompt

The default for the prompt shown in Figure 3.5 is the existing .CR file if defined. The user may type in a new coord. file up to 8 characters without the .CR extension or press the <Enter> key to accept the default value.

Open f_code file

The 'Open feature code file' function will create a new file or open an existing file for use with the data collection modules. Feature codes are pre-defined remarks or phrases which alleviate the hand typing of descriptions, and are detailed in Chapter Eleven. It is identified by the .FC extension and will appear below the coordinate (.cr) file in the information area of the main screen in Figure 3.1.

The 'open feature code file' function produces a pick list similar to the shown in Figure 3.3, showing files with the .FC extension. If one of the existing files is not desired the **ESC** key will produce the prompt shown in Figure 3.6.

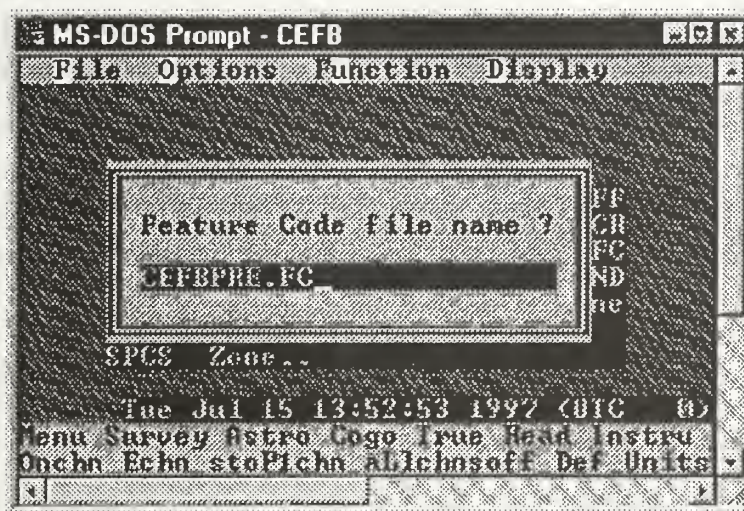


Figure 3.6: Feature Code File Manual Prompt

The default for the prompt shown in Figure 3.6 is the existing .FC file if defined. The user may type in a new feature code file up to 8 characters without the .FC extension or press the <Enter> key to accept the default value.

open Index file

The 'open Index file' function will create a new file or open an existing file to initiate automatic point indexing during data collection, detailed in Chapter Nine. It is identified by the .IND extension and will appear below the feature code (.fc) file in the information area of the main screen in Figure 3.1.

The 'open Index file' function produces a pick list similar to the shown in Figure 3.3, showing files with the .IND extension. If one of the existing files is not desired the **ESC** key will produce the prompt shown in Figure 3.7.



Figure 3.7: Open Index File Manual Prompt

The default for the prompt shown in Figure 3.7 is the existing .IND file if defined. The user may type in a new coord. file up to 8 characters without the .IND extension or press the <Enter> key to accept the default value.

Load chains

The 'Load chains' function loads existing chains from a CEFB chain file into CEFB memory for chain collection. This function and chain collection are detailed in Chapter Ten.

Shell

The 'Shell' function allows access between DOS and CEFB without interruption. Surveyors use this function to execute other DOS programs, and efficiently return to CEFB. Surveyors can return to CEFB from the DOS prompt by typing EXIT.

Surveyors can accelerate this process with the use of a batch file. The dos shell function looks for a **DO.BAT** batch file in the working directory and executes it if found. Surveyors can utilize the DO.BAT file to quickly launch dos programs when executing the dos shell function. For example, a surveyor may frequently utilize the VIEW program which graphically illustrates points with coordinates and their point names. Instead of, exiting CEFB whenever he or she desires to run VIEW, he or she could create a DO.BAT file in the CEFB directory. The DO.BAT file would contain the command VIEW, and VIEW would be executed when the dos shell function was selected.

Version

The 'Version' function will display information about the current version and the date of the CEFB executable as shown in Figure 3.8.

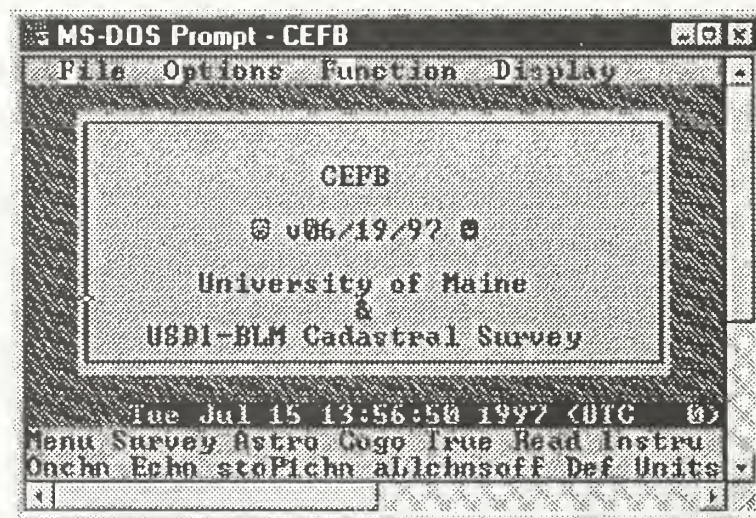


Figure 3.8: Version Display

eXit to dos

The 'eXit to dos' function will terminate CEFB and return the user back to the DOS command line prompt.

Options Menu

There are thirteen functions within the Options pull-down menu, shown in Figure 3.9. Some functions should be defined before data collection, while others are place in the Main Module for convenience.

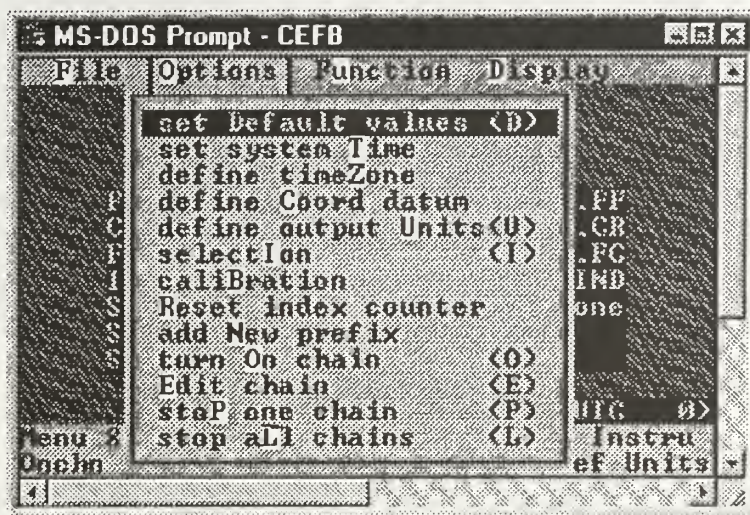


Figure 3.9: Main Module Options Menu

setting the Default values

There are several options in CEFB that users can define or toggle to meet his or her style of collecting data. The 'Set default values' function, or the **D** hotkey, prompts for these options and stores them in CEFB's (CEFB.CF) configuration file. The configuration file also stores CEFB's user (.FF, .CR, .FC, .IND) files shown in Figure 3.1. These options and files are initialized at the beginning of CEFB through CEFB.CF. Once the user defines his or her desired options, one would need to execute this function before data collection, unless he or she needs to change one of the default values.

Default (EDM) Mode

The default mode is the default Electronic Distance Measurement (EDM) mode setting when in the Survey Module. The three settings for the mode are **HVF**, **HVC**, and **HV**. The HV mode has no EDM and only records the Horizontal and Vertical plate readings. This is very useful when doing any sort of triangulation, and is also the default mode in the Astro Module. The HVF and HVC modes differs slightly for each instrument, but generally the HVC (coarse) takes only one EDM reading for a measurement, while the HVF (fine) take two or more EDM readings and then averages them for a measurement. The HVF is recommended for the default mode, however, an example in which the user might want to use the HVC (coarse) mode might be when he or she is having a hard time shooting a sideshot to a high rod or through foliage cover. The Mode can be altered in the Survey Module. The default mode setting prompt is shown in Figure 3.10.

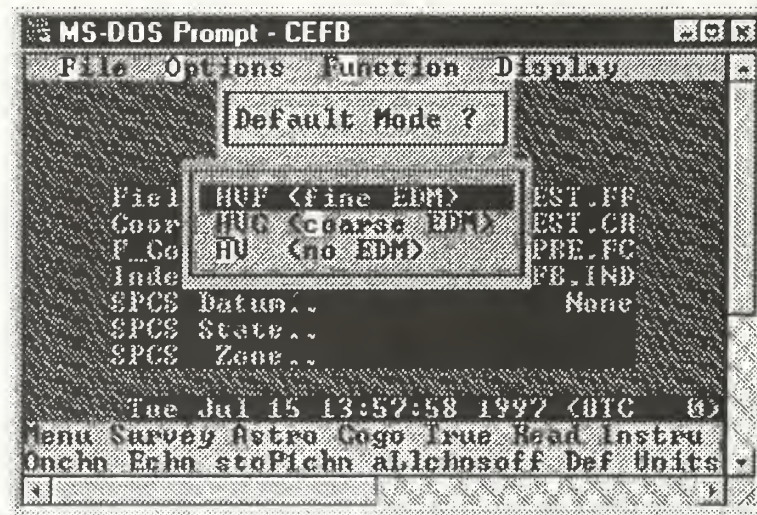


Figure 3.10: Default Mode Setting Prompt

Instrument Timeout

The instrument timeout value defines the amount of seconds the user will allow the instrument to attempt to take an EDM reading for a observation. Allowable values for the instrument timeout are between 0 and 10000. If the instrument does not complete the EDM reading in the allotted time, the instrument will timeout. Twenty seconds is generally a enough time for most EDM's to take an observation. Another method of observing a rod through foliage cover would be to increase the instrument timeout value. The instrument timeout prompt is shown in Figure 3.11.

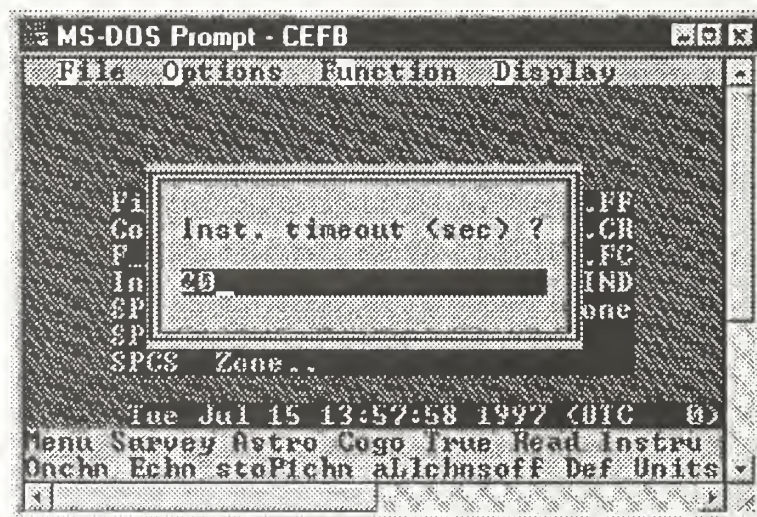


Figure 3.11: Instrument Timeout Prompt

Feet or Meters

The trend of contracts requiring measurements to be in meters has demanded CEFB to have the flexibility to collect observations in feet or meters. The Feet or Meters default defines what unit the instrument is collecting in. The prompt for this default is shown in Figure 3.12.

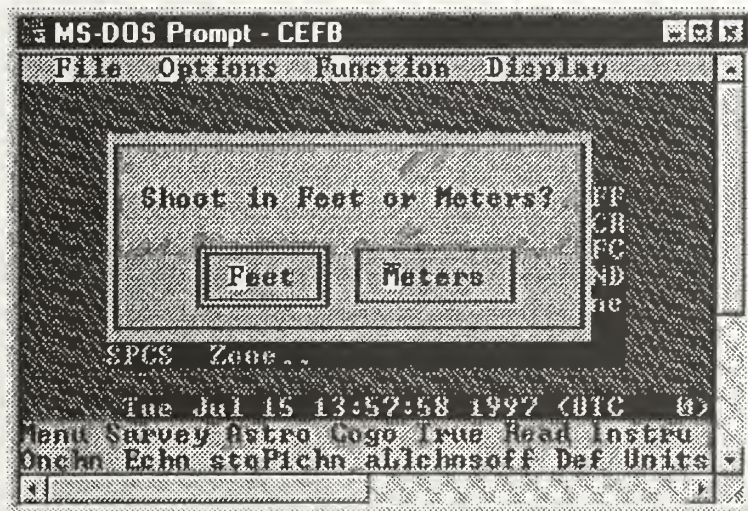


Figure 3.12: Feet or Meters Prompt

When the surveyor selects a choice, a prompt reminds the surveyor of his or her selection as shown in Figure 3.13.

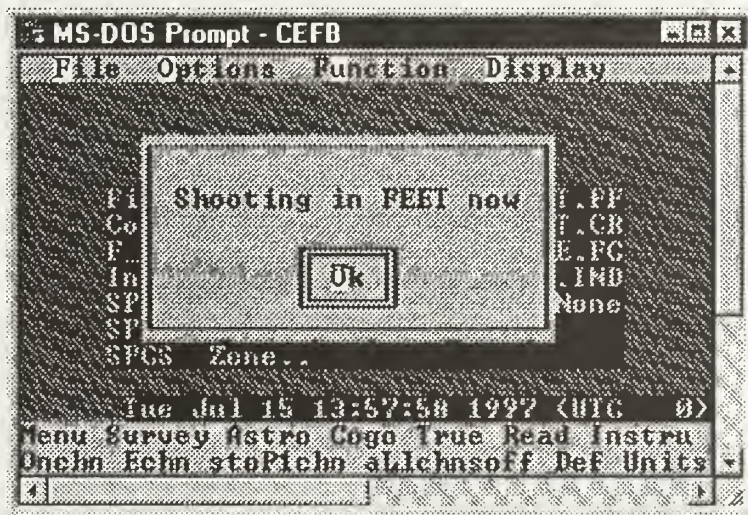


Figure 3.13: Feet or Meters Reminder Prompt

This function is also part of the Instrument pull-down menu of the Survey Module. Surveyors must be aware, however, that their instruments must be set to the same units as defined by the 'Feet or Meters' function.

The unique aspect about the collection unit defined by the 'Feet or Meters' function is that it is entirely separate from the defined horizontal and vertical output units in CEFB. This means surveyors could collect observations in one unit while collecting the coordinates for those observations in another unit. For example, one could collect observations in meters, but have chains defined for the horizontal and vertical output unit in CEFB. Any combination is possible. It is suggested, however, to maintain the same collection and output units to avoid confusion.

Prompt for HI's and HT's

If a surveyor is interested in collecting three dimensional data out in the field, it is extremely important to record the height of the instrument and the foresight target for all observations. The prompt shown in Figure 3.14 displays the prompt to set the defaults for prompting for those heights whenever a setup or new FS is created.

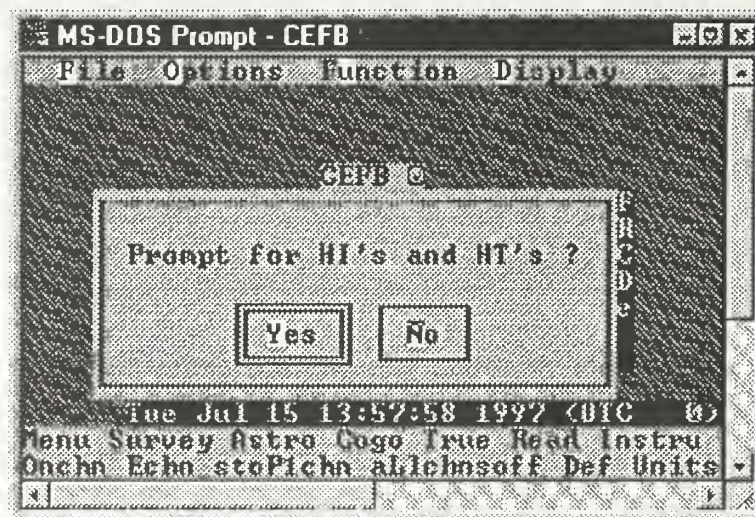


Figure 3.14: Prompt for Height of Instrument and Target

If the surveyor is truly not interested in collecting three-dimensional information, it is recommended to set this default to no to avoid increasing the number of required keystrokes for each observation. Regardless of the choice in Figure 3.14, the surveyor is still prompted to define the default height of instrument and target as shown in Figures 3.15 and 3.16.

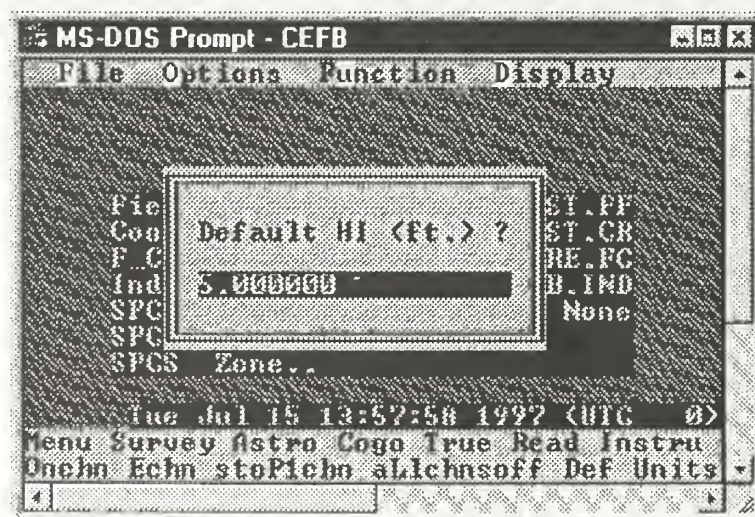


Figure 3.15: Default HI Prompt

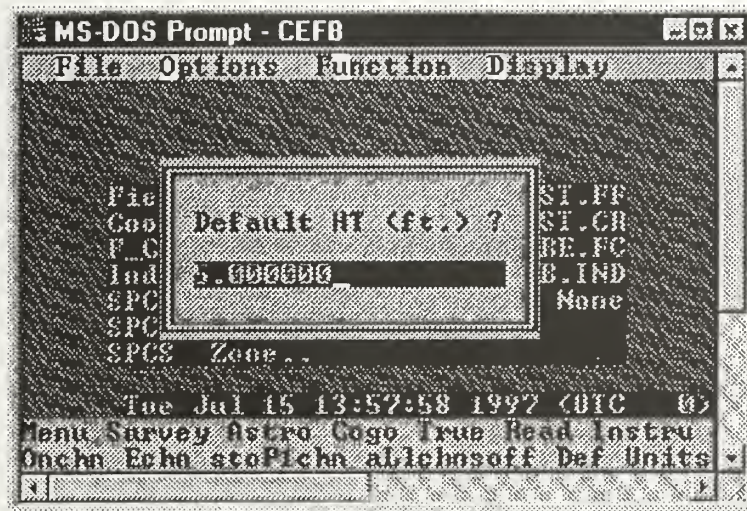


Figure 3.16: Default HT Prompt

The prompts shown in Figures 3.15 and 3.16 will always have the define output unit, as feet is the example above.

Automatic Backsight Observations

The ever increasing need for checks to the BS can be automatically taken care of with the acceptance of the prompt shown in Figure 3.17.

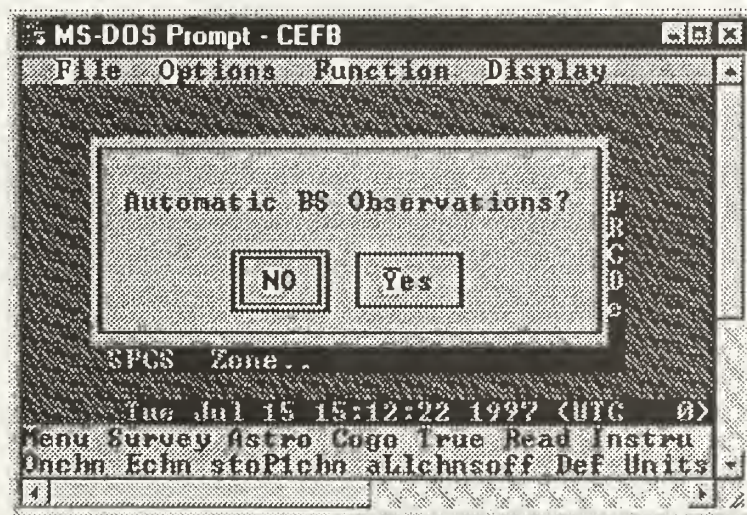


Figure 3.17: Automatic Backsight Observation Prompt

When this default is accepted, CEFB will automatically shoot the BS as a FS immediately after the horizontal circle is set to 0°00'00" on the BS with the Poll function. The instrument does not need to be touched between these two observations. If this default is on while in manual mode, the user will be prompted for the BS horizontal plate reading (dd.mmss), HT to BS, if HI and HT prompt turned on, Zenith circle (dd.mmss), and Slope dist. The observation to the BS will appear in the the Survey Module Screen as shown in Figure 3.18.

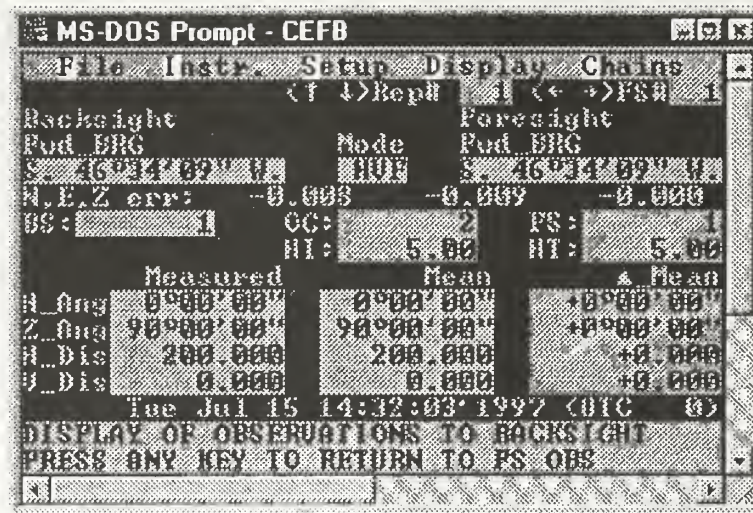


Figure 3.18: Automatic BS Observation Display

The hotkey lines in the Figure 3.18 notifies the user that he or she is observing the data pertaining to the observation to the BS. Any key will return the user to the screen pertaining to the first defined FS of the setup. The following is an observation (.obs) file depicting a typical setup with this functionality.

```
S 1      2      5.000                      Tue Jul 15 14:31:40 1997
B 0 0 0.0
F 1      1 5.000 0 0 0.0 90 0 0.0 200.000 0.000 Tue Jul 15 14:32:06 1997
F 3      1 5.000 123 0 0.0 90 0 0.0 123.000 0.000 Tue Jul 15 14:40:20 1997
B 0 0 0.0
F 1      1 5.000 0 0 0.0 90 0 0.0 200.000 0.000 Tue Jul 15 14:40:33 1997
F 3      1 5.000 123 0 5.0 90 0 0.0 123.000 0.000 Tue Jul 15 14:40:39 1997
```

The observation to the BS in the above example are given the 'F' record, and are handled as FS observations in TOLSA. This functionality can be manually performed in the Survey Module, however, the with this default turned on, it can eliminate the number of keystrokes required manually.

The poll BS function performs normally when this default is turned off. The following is an observation (.obs) file of the same example shown above with out the 'Automatic BS Observation' default on.

```
S 1      2      5.000                      Tue Jul 15 14:31:40 1997
B 0 0 0.0
F 3      1 5.000 123 0 0.0 90 0 0.0 123.000 0.000 Tue Jul 15 14:40:20 1997
B 0 0 0.0
F 3      1 5.000 123 0 5.0 90 0 0.0 123.000 0.000 Tue Jul 15 14:40:39 1997
```


Automatic Overwrite

Collecting coordinates in the field is a very important aspect in surveying. Coordinates drive several functions executed by surveyors in a field environment. The most frequent error in coordinate collection is managing the correlation of station ID's to their proper coordinates. The Automatic Overwrite default surveys to supervise the collection of coordinates and its link to station ID's. This default, when toggled on, notifies surveyors whenever a FS station ID is polled which already exists in the CEFB coordinate file (excluding repetitions). The prompt to activate the Automatic Overwrite feature is shown in Figure 3.19.

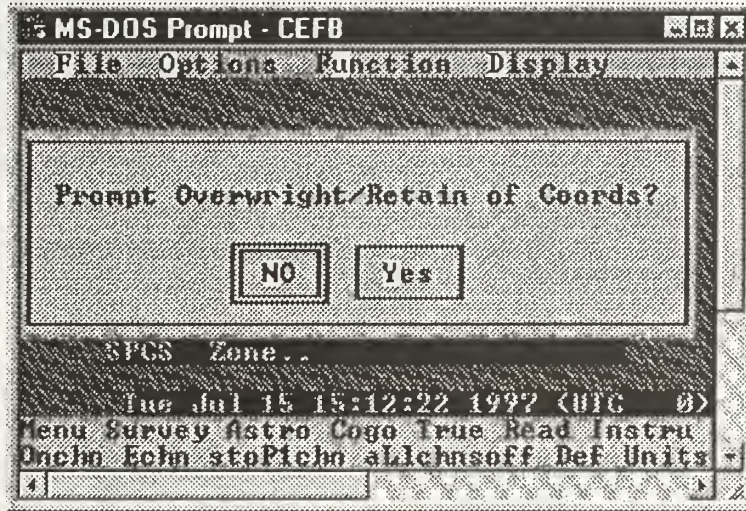


Figure 3.19: Automatic Overwrite Default Prompt

When this feature is activated, the prompt shown in Figure 3.20 allows surveyors to make the choice of retaining or overwriting existing coordinates for the FS station. Coordinates are always retained when this feature is toggled off, however, surveyors can still use the 'Overwrite Coord.' function (setup pull-down menu of the Survey Module, described in Chapter Four) to overwrite desired coordinates. An example of a need to overwrite coordinates occurs whenever a new FS was measured to, but the prism was not yet stable or over the desired point.

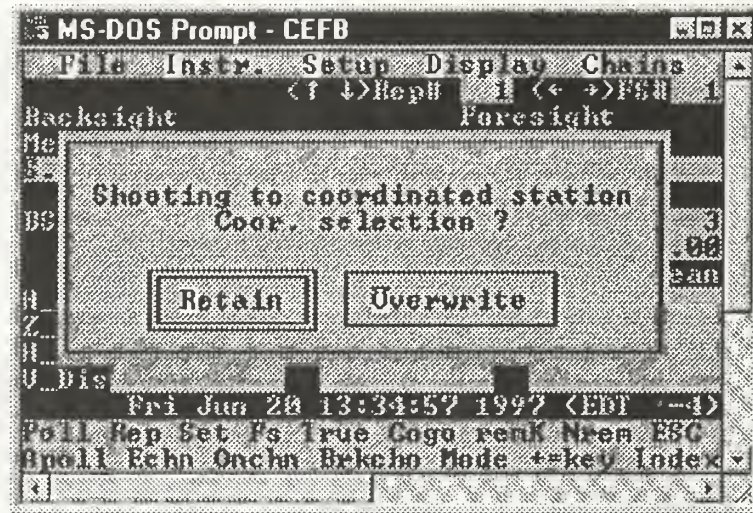


Figure 3.20: Automatic Overwrite Prompt

Attach Old Remark to OC or FS

Feature codes can be executed one of two ways, the 'Auto remark' function in the Survey Module (Described in Chapter Nine), or the 'old remark' function in the survey or Trueline Module. The 'old remark' function displays a pick list of available feature codes in the feature code file. Before this occurs the surveyor is asked to define the station to attached the remark to. This prompt is shown in Figure 3.21.

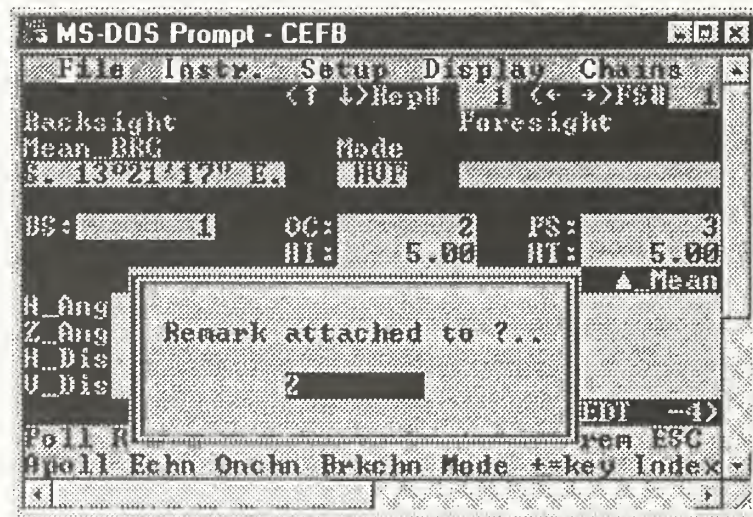


Figure 3.21: Attach Remark Prompt

The default station shown in the prompt in Figure 3.21 can be defined by the surveyor to be the occupied or the foresight station in the 'set default values' function. The OC and FS stations are the most common described stations at the time of description execution, and gives the surveyor the ability to define one of the two fields as the default station. This prompt is in Figure 3.22

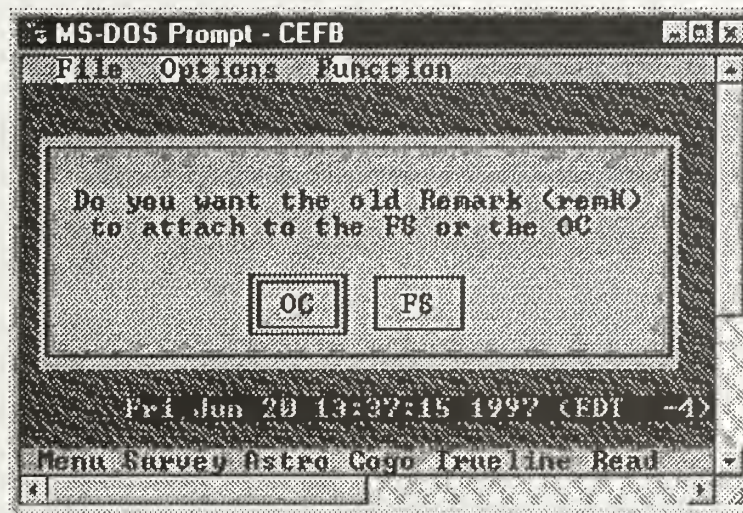


Figure 3.22: Attach Old Remark Default Station Prompt

Auto Save Interval

The Auto-Save Interval default enables surveyors to define the number of seconds to elapse without key interaction before CEFB prompts the surveyor to save the current setup with the prompt shown in Figure 3.23.

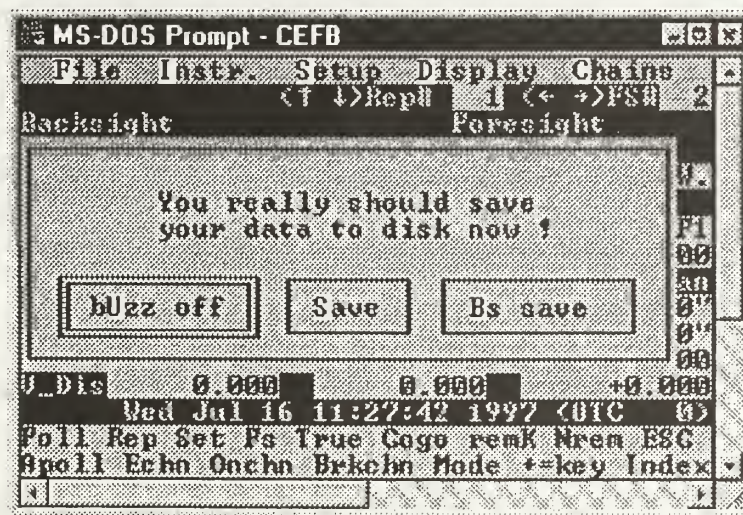


Figure 3.23: Save Data to Disk Prompt

This option was designed to facilitate surveyors not saving data as frequently as they should. This usually occurred in topographic collection when surveyors are at an occupied station for a long period of time. If the surveyor knows he or she is not going to be in that of setting, and frequently is saving data to disk by other operations, he or she has the option of eliminating the possibility of the prompt in Figure 3.23. This is accomplished by entering by a negative or zero value in the prompt shown in Figure 3.24 of the 'set Default values' function.

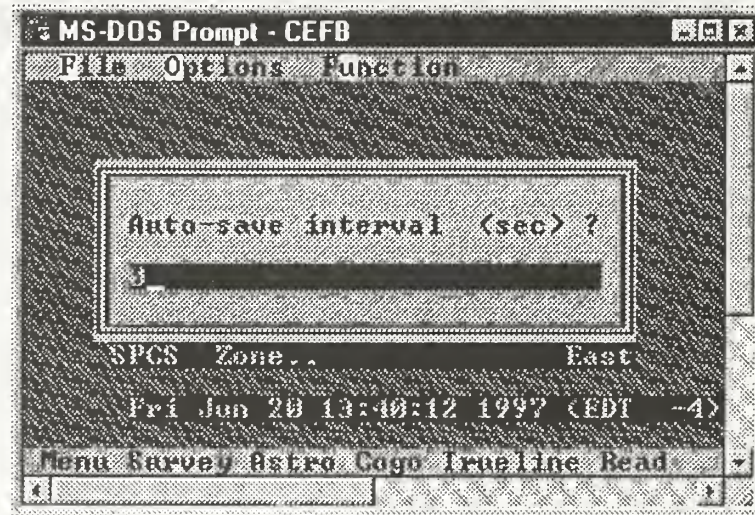


Figure 3.24: Auto-Save Interval Prompt

If the surveyor does decide to utilize this option, generally 120 seconds or two minutes is a good Auto-save interval. When this option is utilized, there are three options the surveyor can select when the prompt in Figure 3.23 appears.

The **bUzz off** option will return the surveyor to the Survey Module with out saving any data. The **Save** option will save the data in the current setup, create a new setup without moving up, and prompt for the next foresight. The **Bs save** option performs the same steps as the **Save** option, except before those steps the surveyor is prompted to close back upon the Back sight with the prompt shown in Figure 3.24.

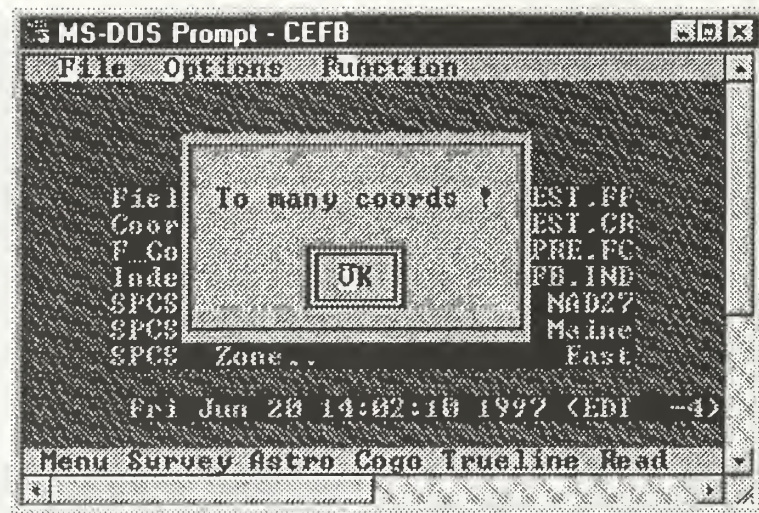


Figure 3.27: Too Many Coordinates

The surveyor will only be able to access the first (max no.)th of coordinates in the (.cr) file. If one encounters this prompt, it is highly recommended to increase the maximum number of coordinates.

set system Time

This option sets the DOS time used to time-stamp all observations. This function is shown in Figure 3.28. This function can also be completed with the **time** command at the DOS prompt.

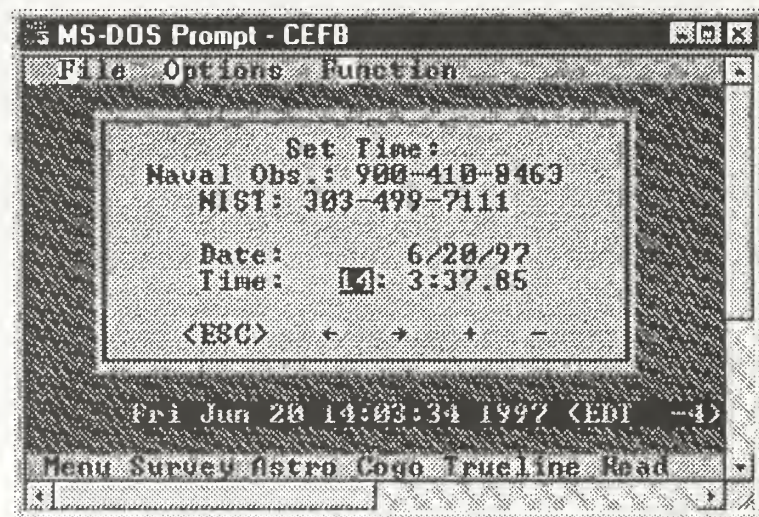


Figure 3.28: Set System Time

The menu in Figure 3.28 also displays two phone numbers. One number reaches the Naval Observatory Master Clock while the other reaches the National Institute of Standards and Technology (NIST) and there recordings of current coordinated universal time. These numbers can aid in setting accurate times when needed for solar and/or polaris observations when the surveyor does not have time cube. The following steps set the time in Figure 3.28.

1. Highlight the portion of the time that you wish to change (hour, minute, second) using the left or right arrow keys.
2. Press the + or - keys to add or subtract time. The + and - keys must be pressed while holding down the <Shift> key.
3. Exit the function by pressing the <Esc> key.

define timeZone

When the surveyor is setting his or her time with the set system time function to a local time zone, he or she must define the time zone offset from coordinated universal time. This function displays a pick list of time zones shown in Figure 3.29. If the surveyor sets the system time to match coordinated universal time, the surveyor should select **UTC 0** in the pick list in Figure 3.29.

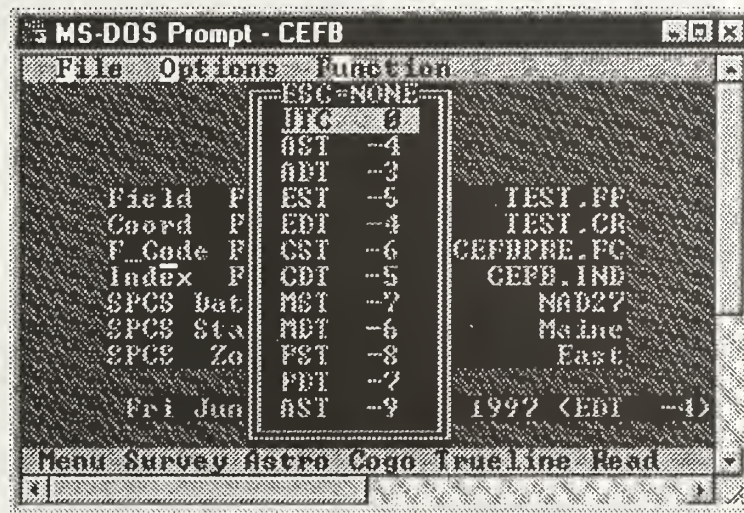


Figure 3.29: Time Zone Pick List

There are two values for each selection in the pick list shown in Figure 3.29. The first value is an abbreviation of the available time zones or the zone ID, and the second value is the hours that the time zone is behind Greenwich Time (UTC). The zone ID has three characters. The first character defines the time zone, while the last 2 character define whether it is in standard or daylight saving time. The available time zones in CEFB are Greenwich, Atlantic, Eastern, Central, Mountain, Pacific, Alaska, and Hawaii-Aleutian.

define Coord datum

This function allows surveyors to define a geodetic or plane datum environment when collecting observations. A geodetic datum should be chosen for most applications, however, specific instances may require the use of the plane mode (e.g. straight line intersections). In geodetic mode earth curvature and meridian convergence corrections are utilized by defining a State Plane Coordinate System (SPCS) zone. If no coordinate file is defined, this function has no effect on the data collection aspect of CEFB. The first prompt on this function is shown in Figure 3.30.

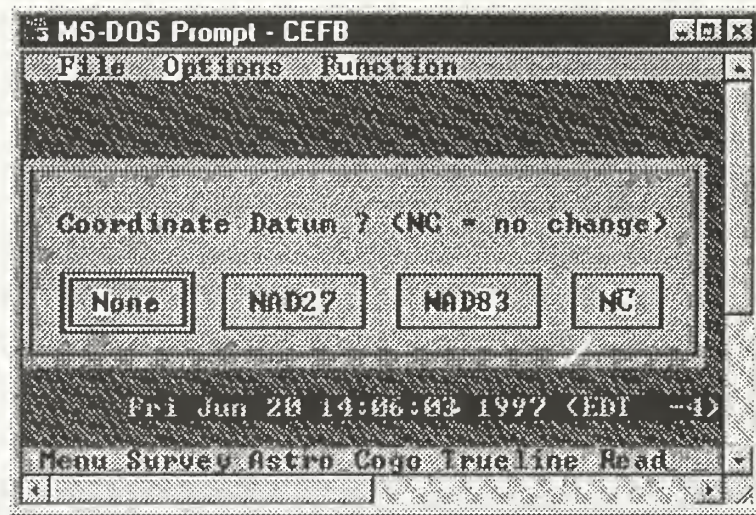


Figure 3.30: Define Datum Prompt

Once the surveyor makes his or her selection, those definitions are displayed in the main menu. If the surveyor chooses either of the geodetic datums he or she will then be prompted for selection of the appropriate state plane zone in the pick list shown in Figure 3.31.

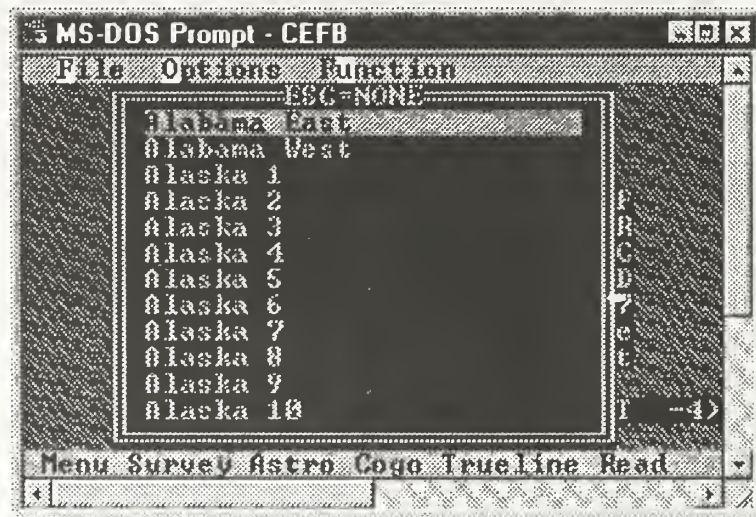


Figure 3.31: State Plane Zone Definition

The list of state plane zones in Figure 3.31 has pick list functionality, and desired selections can be reached with character hot keys.

define output Units

The 'define output Units' function, or the U hotkey, allows the operator to change the defined linear units in CEFB. This function is located in the Main and Cogo Modules. Although this function will typically be utilized in the Cogo Module, it is positioned in the Main Module for convenient access. This function is detailed in the Option Menu section of Chapter Six.

Selection

The 'Selection' function, or the **I** hotkey, allows an operator to select the type of survey instrument in use. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function is detailed in the Instrument Menu section of Chapter Four.

Calibration

The 'Calibration' function allows the operator to calibrate a total station for horizontal and vertical collimation errors. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function is detailed in the Instrument Menu section of Chapter Four.

Reset index counter

The 'Reset index counter' function resets the suffixes of all point prefixes in the index (.ind) file to one (Only usually done at the beginning of a job to restart indexing of prefixes at one). This function and automatic point indexing are detailed in Chapter Nine.

aDding a new prefix

The 'aDd new prefix' function provides the ability to add elements to the index file on the fly while in the field. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function and automatic point indexing is detailed in Chapter Nine.

turn On chain

The 'turn On chain' function, or the **O** hot key, allows users to activated features from the index file for chain collection. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function and chain collection is detailed in Chapter Ten.

Edit chain

The 'Edit chain' function, or the **E** hot keys, gives the users ability to manually observe, edit, and manipulate chains in the field. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function and chain collection is detailed in Chapter Ten.

stoP one chain

The 'stoP one chain' function, or the **P** hotkey, inactivates one feature from chain collection. This function is located in the Main and Survey Modules. Although this function will typically be utilized in the Survey Module, it is positioned in the Main Module for convenient access. This function and chain collection is detailed in Chapter Ten.



Figure 3.33: Main Module Display Menu

change Angular disp.

The 'change Angular disp.' function allows surveyors to define direction quantities displayed in CEFB as bearings or azimuths. All subsequent direction displays within CEFB will be affected. This setting is also stored CEFB's (.cf) configuration file. Examples of displays areas affected by this function are in the Cogo Module when inversing and intersecting, in the survey and Astro Module in the BS and FS direction field, and in the Trueline Module in the direction fields between stations. Figure 3.34 displays the change angular display prompt.

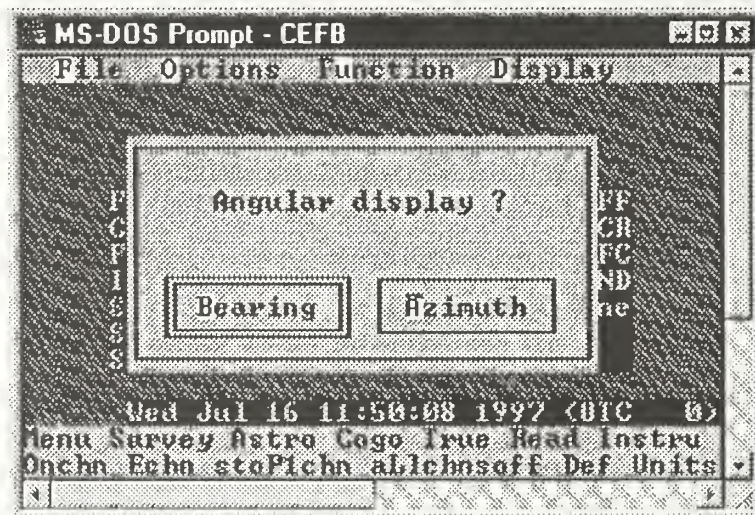


Figure 3.34: Angular Display Prompt

Fwd/mean disp.

The 'Fwd/mean disp.' function allows surveyors to define direction quantities displayed in CEFB while in geodetic mode as forward or mean bearings/azimuths. The fwd/mean display is only effective when in a geodetic environment. This setting is also stored CEFB's (.cf) configuration file. Examples of displays areas affected by this function are in the survey and Astro Module in the BS and FS direction field, and in the Trueline Module in the direction fields between stations. Figure 3.35 displays the fwd/mean display prompt.

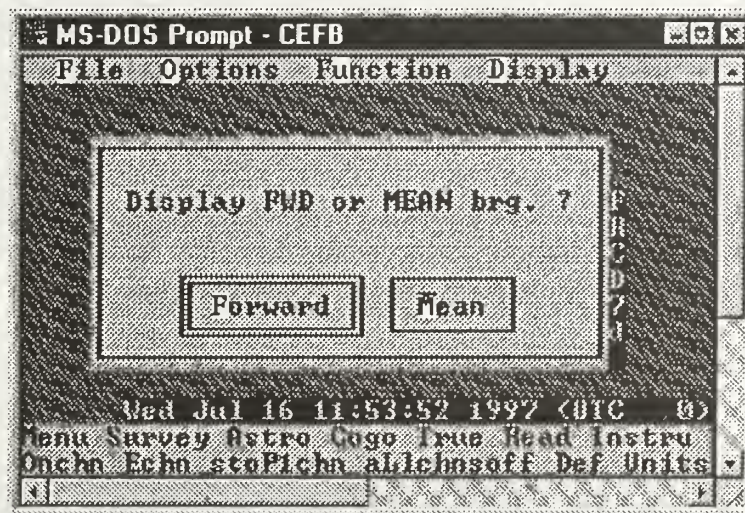


Figure 3.35: Forward/Mean Display Prompt

CHAPTER FOUR - CEFB - Survey Module

Main Screen

A typical survey 'setup' in CEFB is defined by three parts, the back sight (BS) station, the occupied (OC) station, and the foresighted (FS) station(s). Every setup will have at least one BS, OC, and FS station. Additionally, every setup will have at least one repetition associated with it. A repetition is defined as the collection of all FS stations containing the same BS horizontal plate reading. There is no pre-determined number of FS stations per repetition or number of repetitions per setup that is allowed.

Once activated the operator is immediately prompted for the back sight station, occupied station, HI, foresight station and HT. If the operator has turned off the HI/HT prompt, the default values will be used. Station names can be eight characters long and are alpha-numeric, therefore any combination of letters and/or numbers is acceptable. Once all the prompts have been answered, a screen similar to what is shown in Figure 4.1 will be displayed.

If the surveyor wishes to turn on or off the HI/HT prompt, this may be accomplished with the 'set Default values' function in the options menu of the Main Module described in Chapter Three.

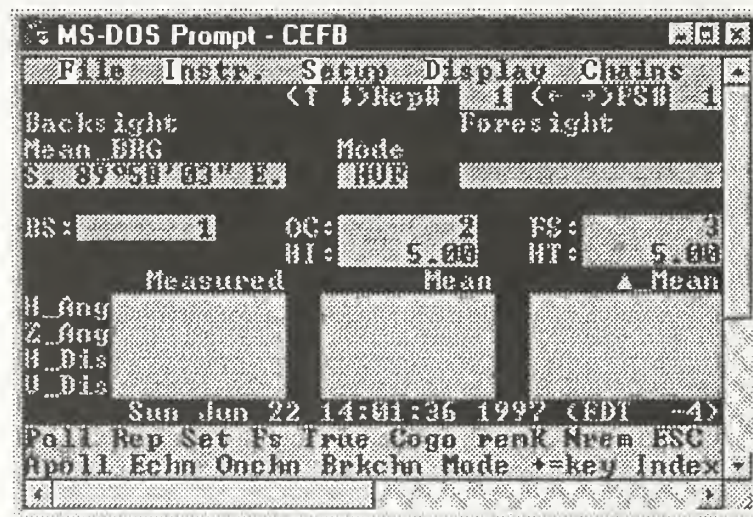


Figure 4.1: Survey Module

The main screen of the Survey Module shown in Figure 4.1 contains a great deal of information. The top line is the pull-down menu bar. The second line contains a repetition index number and a FS index number. These indices allow the operator to keep track of 'where the screen is' in relation to the current 'setup'. Only one observation to a single FS is displayed at any given time.

The operator may view any observation in the current setup to any FS station in any repetition by using the left, right, up or down arrow keys. The left/right arrow keys scroll through the different FS stations (FS#) within a given repetition. The up/down arrow keys scroll through the repetitions (Rep#) of a given setup. These observations can be re-observed, if desired, within a the current setup. An example of this could be the erroneous location of a side shot. The surveyor realizes this error during subsequent observations at this current setup. He or she could then use the left, right, up, or down arrow keys to position the setup at the desired observation. The surveyor could then use the 'Poll' function (discussed in later in this chapter) to re-observe the side shot. Once data for a setup has been saved to the field file using the 'new Setup' function, observations may only be viewed and edited using the Read/Edit Module.

The third, forth and fifth lines contain information about the BS and FS bearings and the Present Measurement mode. The information on the left side pertains to the BS bearing, the information on the right side pertains to the FS bearing, and the information in the center displays the current EDM mode setting. From Figure 4.1 you can see that the BS bearing is defined to be N. 89°18'59" E., mean geodetic, and the current mode is set to measure both horizontal and vertical circle readings, as well as slope distances in the fine measurement mode (HVF).

The next two lines indicate the BS, OC, and current FS stations, including the associated HI and HT values. This information, with the exception of the FS station and HT, will remain constant throughout the current setup unless the operator edits the identification data.

The next five lines contain information relating to the observation specific to the indicated FS station. This information is organized into three separate columns. The first column pertains to the current observation, the second column is the mean of all of the observations to the indicated FS station, and the third column is a numerical difference between the first two columns.

These five rows are organized into four specific areas relating to different portions of the observation: horizontal angle, zenith angle, horizontal distance, and vertical distance. Some or all of these rows will be populated, depending on what the current mode setting is. If the mode were set to 'HV' there would be no information about horizontal or vertical distances shown since the operator had chose not tho measure a slope distance.

The next line contains the current system date and time along with the defined time zone. And finally, the bottom two lines are the hot key bars in which the capitol letters activate the functions.

File Menu

The file menu, shown in Figure 4.2, of the Survey Module is similar to the File menu of the Main Module. The file menu contains already discussed functions such as Cogo, Trueline, Shell, and Version. The **Cogo** and **Trueline** functions bring the user to there respective Modules. When these modules are initiated in the Survey Module, control is returned to the Survey Module when exited. The Cogo Module is detailed in Chapter Six, while the Trueline Module is detailed in Chapter Seven. The **Shell** and **Version** functions are discussed in the file menu section of the Chapter Three (Main Module).

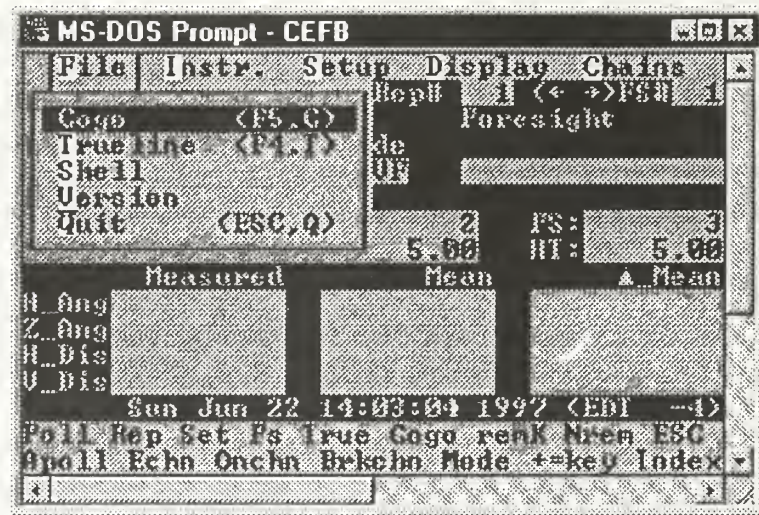


Figure 4.2: Survey Module File Menu

Quit

The 'Quit' function, or the Q or ESC hot keys, will return the surveyor back to the Main Module. data. The prompt for this function is shown in Figure 4.3.

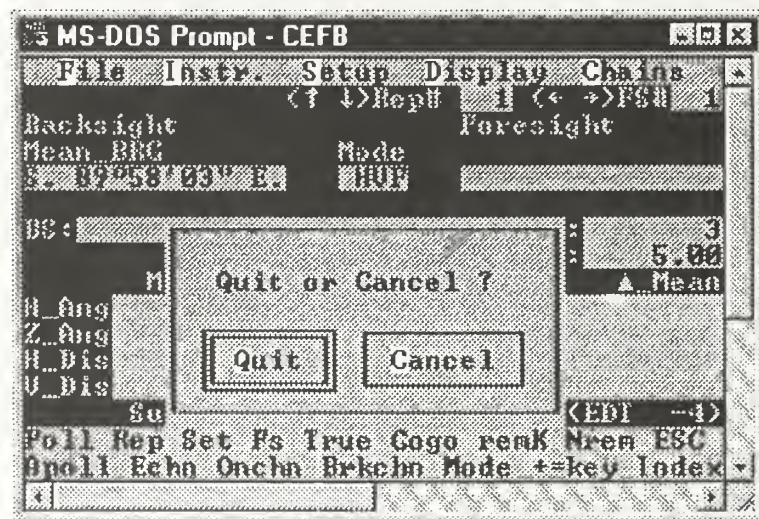


Figure 4.3: Quit Survey Module Prompt

The **Cancel** option will return the surveyor to the Survey Module. This does not affect previously collected data. The **Quit** option will automatically save the data of the current setup, if data exists, and return the surveyor Main Module.

Instrument Menu

The functions within the Instrument Menu pertain to functions associated with the instrument and automatic point indexing. This menu is shown in Figure 4.4.

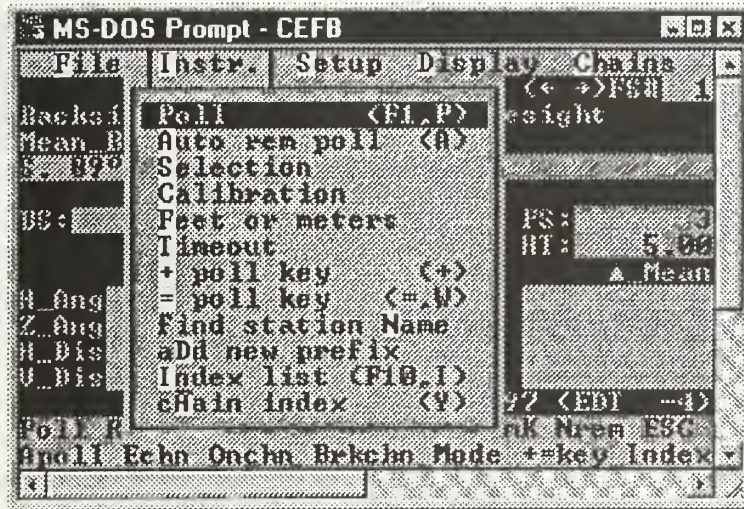


Figure 4.4: Survey Module Instrument Menu

Poll

The 'Poll' function, or the F1 or P hot keys, is how the surveyor commands the instrument to collect information, it is used for both back sighting and fore sighting.

When the 'Poll' function is activated while back sighting, CEFB will ask whether the operator is truly looking at the back sight. If answered 'Yes' the plate on the instrument will be set to zero. This value, 0° 0' 0", will be recorded as the back sight angle in the CEFB field file (.ff). This prompt is shown in Figure 4.5.

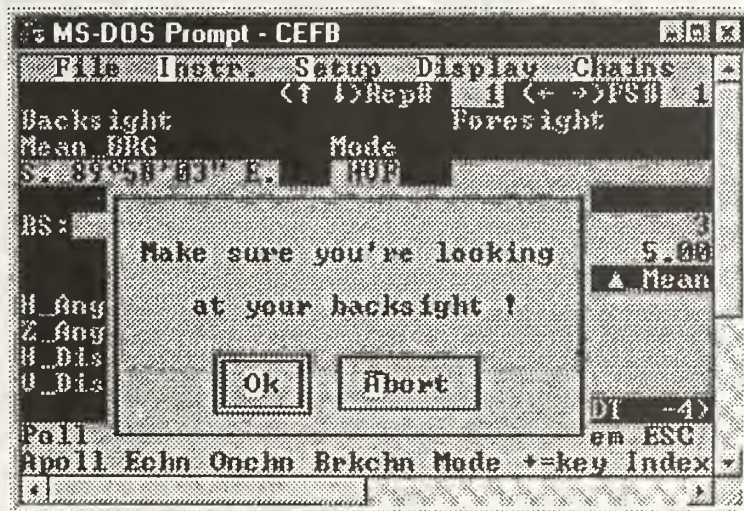


Figure 4.5: Back sight Prompt

When the 'Poll' function is activated while fore sighting, a pop-up window will appear, signifying that data is being collected. Once the requested data is received from the instrument, this window will disappear and the data will be displayed on the survey data collection screen. If no response is received within the allocated timeout period a warning will be displayed to the operator. If this occurs you may wish to increase the instrument timeout value.

Auto rem poll

The 'Auto rem poll' function, or the A hot key, performs the same operations as the 'Poll' function and then executes the feature code corresponding to the prefix in the FS field. This function and automatic point indexing are detailed in Chapter Nine.

Selection

The 'Selection' function allows an operator to select the type of survey instrument in use. In addition to several common electronic total stations, the operator also has the ability to select a manual data entry mode. The manual entry mode operates similar to the others, except that when the 'Poll' function is executed the operator is prompted for the required hand input. Manual entry is useful if the communications cord to the instrument is damaged, or when entering measurements from a taped distance. Once an instrument has been selected, this information will be written to the CEFB.CF configuration file, and will remain effective until the operator changes the instrument, or until the CEFB.CF file is deleted. The available instruments and the prompt for this function are shown in Figure 4.6. It is the goal in the near future to interface CEFB with more instruments.

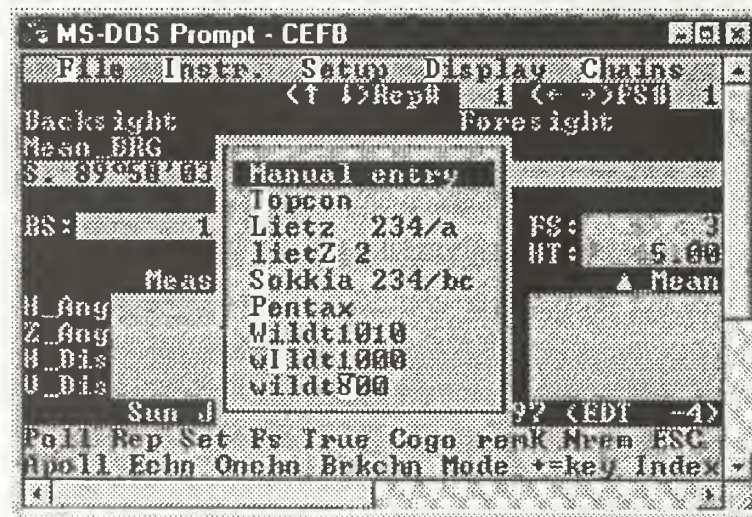


Figure 4.6: Instrument Selection Pick List

Calibration

The 'Calibration' function allows the operator to calibrate a total station for horizontal and vertical collimation errors. Once collected, this data may be written to the .FF file for post-processing by TOLSA.EXE. This process should occur at the beginning of each project and whenever instrument collimation changes.

When the 'Calibration' function is invoked, the screen in Figure 4.7 will be displayed. A brief reminder of the steps for calibration are listed on the first four lines of the screen. Below these are counters for the direct and reverse sightings, the accumulated errors of the circle readings, their respective means, and finally the hot key bar on the bottom line of the screen.

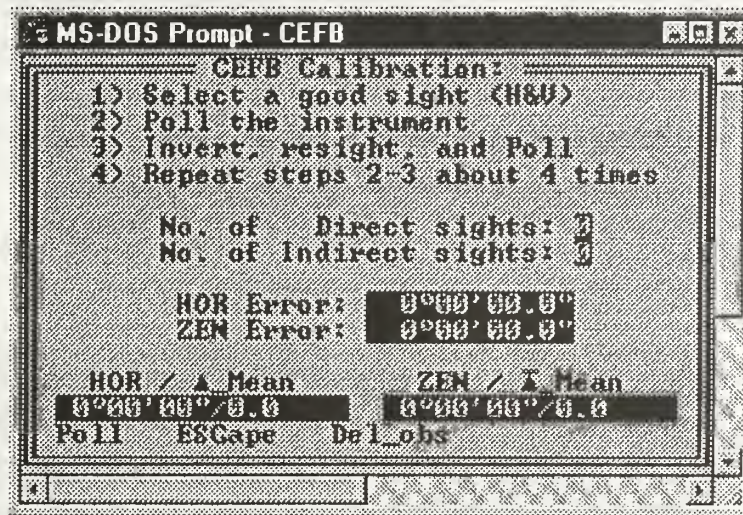


Figure 4.7: Calibration Screen

Calibration Steps

1. Sight on an object/target that is distinguishable in both the horizontal and vertical directions. This target should be a suitable distance away from the instrument. A prism may be a good sight, however is not a necessary one. The 'Calibration' function automatically sets the mode to HV, therefore, no distance is measured.
2. Poll the instrument.
3. Invert the scope of the instrument and re-sight on the original target.
4. Poll the instrument again.
5. Repeat steps 1-4 several times. One wants to repeat this step several time to arrive at a accurate average of the horizontal and vertical collimation errors for the instrument.
6. If a bad sighting is observed, the observation may be deleted by using the 'Del_obs' functions from the short cut menu (press D).
7. When completed, press the <Esc> key and Quit at the Quit or Cancel prompt. The cancel selection will return the operator to the calibration screen. Once the Quit option is selected, the operator is prompted to save current data. The yes option will save the current data, while the no option will not save the current data before returning to Survey Module.

Calibration Affects

When the TOLSA program finds Calibration records in the observation (.obs) file it reduces the calibration observations and computes a horizontal and vertical collimation corrections or constants. These constants are applied only to the remaining horizontal and vertical observations within the observation (.obs) file. These constants do not take affect through an entire (.lsa) file or consequent observation (.obs) files. This function can be used to test an instrument's existing collimation error at the beginning of a job or after a period of physical activity for an instrument. After several repetitions , if the computed horizontal and vertical collimation errors are smaller than the standard error estimate for angles, it is not required to save the calibration observation.

Feet or meters

The 'Feet or meters' function toggles between feet and meter as the defined unit the instrument is collecting in. The prompt for this function is shown in Figure 4.8.

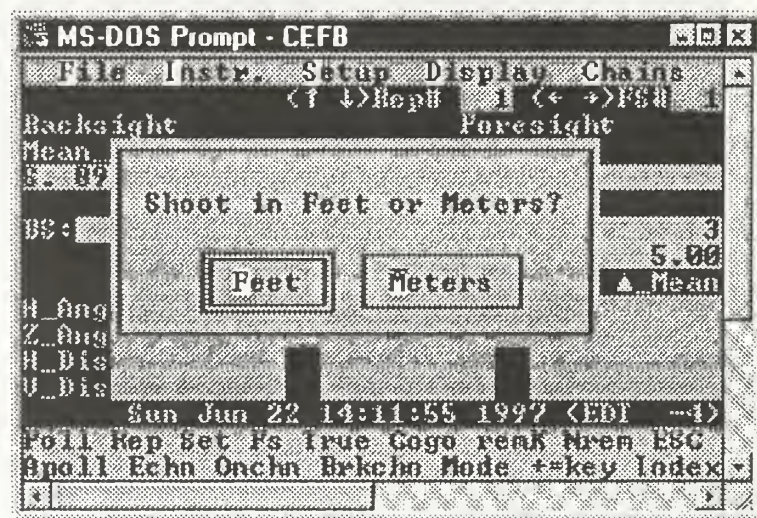


Figure 4.8: Feet or Meters Prompt

When the surveyor selects a choice, a prompt reminds the surveyor of his or her selection as shown in Figure 4.9.



Figure 4.9: Feet or Meters Reminder Prompt

This function is also part of the 'set Default values' function of the Main Module, and this value is stored in CEFB's (.cf) configuration file. Surveyors must be aware, however, that their instruments must be set to the same units as defined by the 'Feet or meters' function.

The unique aspect about the collection unit defined by the 'Feet or meters' function is that it is entirely separate from the defined horizontal and vertical output units in CEFB. This means surveyors could collect observations in one unit while collecting the coordinates for those observations in another unit. For example, one could collect observations in meters, but have chains defined for the horizontal and vertical output unit in CEFB. Any combination is possible. It is suggested, however, to maintain the same collection and output units to avoid confusion.

Timeout

The 'Timeout' function defines the amount of seconds the user will allow the instrument to attempt to take an EDM reading for a observation. Allowable values for the instrument timeout are between 0 and 10000. This values is stored in CEFB's (.cf) configuration file. If the instrument does not complete the EDM reading in the allotted time, the instrument will timeout. Twenty seconds is generally a enough time for most EDM's to take an observation. Another method of observing a rod through foliage cover would be to increase the timeout value. This prompt is also part of the of 'set Default values' function of the Main Module. The instrument timeout prompt is shown in Figure 3.11.

+ poll key

The '+ poll key' function, or the + hot key, facilitates the consecutive collection of numerical observations of the same feature from one occupied station. This function and automatic point indexing are detailed in Chapter Nine.

= poll key

The '=' poll key' function, or = or W hot keys facilitates the consecutive collection of numerical and descriptions observations of the same feature from one occupied station. This function and automatic point indexing are detailed in Chapter Nine.

find station Name

During the course of a survey it can be desirable to measure to an existing station and have CEFB determine which point has been measured to. Coordinates are required for the BS, OC, and FS stations. This can occur, for example, on a closing station of a traverse in which the markings have worn off. The 'find station Name' function searches the CEFB coordinate file and finds the closest station ID based on the angle and distance observed from known OC and BS stations. Figure 4.10 displays the first prompt of the function.

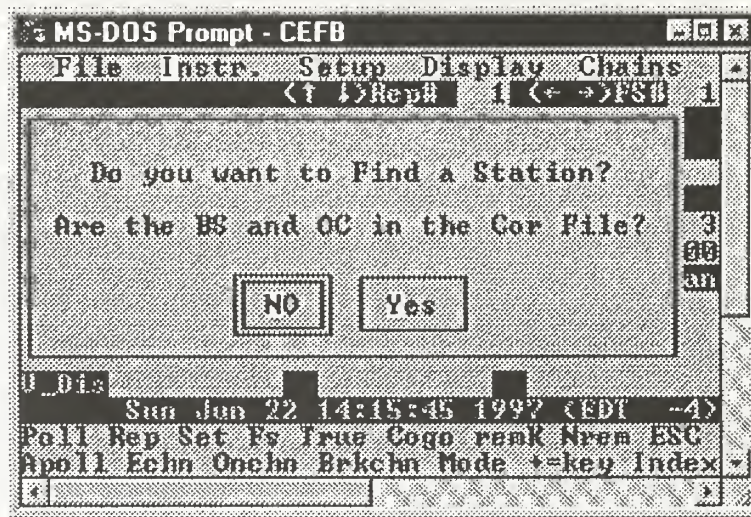


Figure 4.10: Find Station Name Prompt

The 'find station Name' function can only be initiated if a measurement to the BS station has been made. The function will continue only if the BS and OC station ID's are in CEFB coordinate file. Figure 4.11 displays the next prompt for the 'find station Name' function.

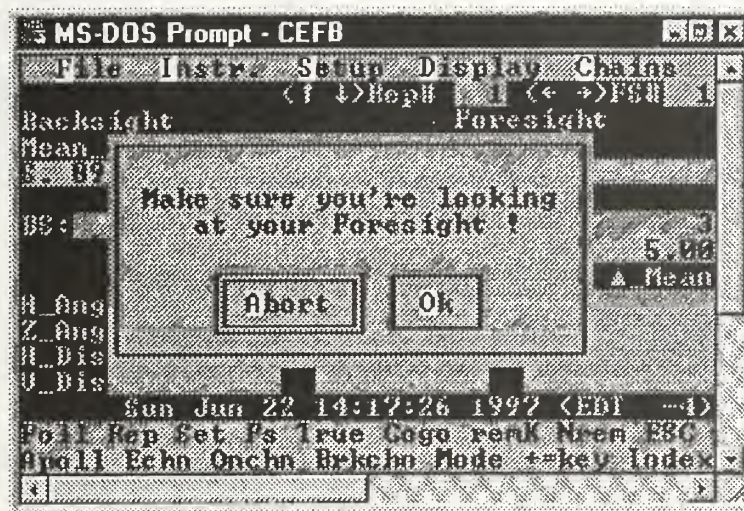


Figure 4.11: Sight Foresight Prompt

The instrument is immediately polled once **Ok** is selected in the prompt shown in Figure 4.11. CEFB calculates the closest station ID in the CEFB coordinate file based on the observed angle and distance. The results of this function are shown in Figure 4.12.

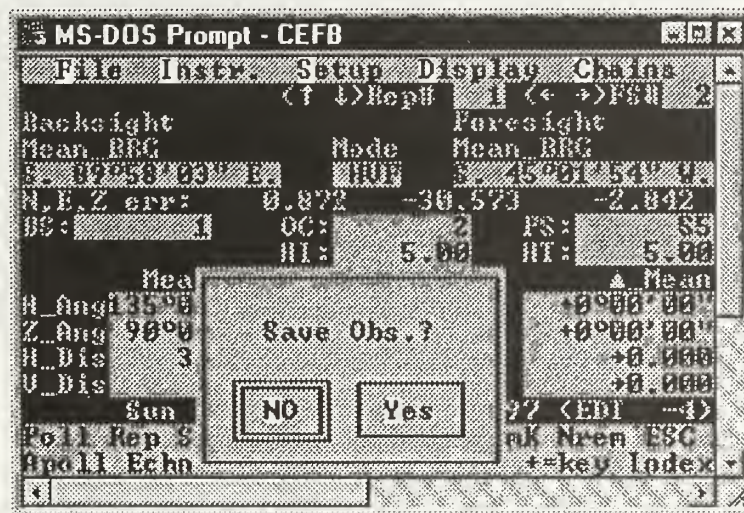


Figure 4.12: Find Station Name Results

The resulting station ID is displayed in the FS station field, while the Northing, Easting, and Elevation (N.E.Z.) error between the observed location and the station's existing coordinates is also shown. The surveyor can then choose to save or not save the observation as shown in Figure 4.12. If the surveyor selects not to save the observation, control is returned to the existing setup as if the operation never took place.

Adding a new prefix

The 'aDd new prefix' function provides the ability to add elements to the index file on the fly while in the field. This function and automatic point indexing is detailed in Chapter Nine.

Index list

The 'index list' function, or the **F10** or **I** hot key, is the work horse of automatic point indexing and displays list of available prefixes in the index file to produce a (prefix/suffix) station ID. This function along with automatic point indexing are detailed in Chapter Nine.

cHain index

The 'cHain index' function, or the **Y** hot key, performs the same function as the 'index list' function, except that only activated chain feature prefixes are written to the pick list. This facilitates the collection of chains. This function along with chain collection are detailed in Chapter Ten.

Setup Menu

The Setup menu contains functions pertaining to setups, repetitions, station editing, and feature codes. The setup menu is shown in Figure 4.13.

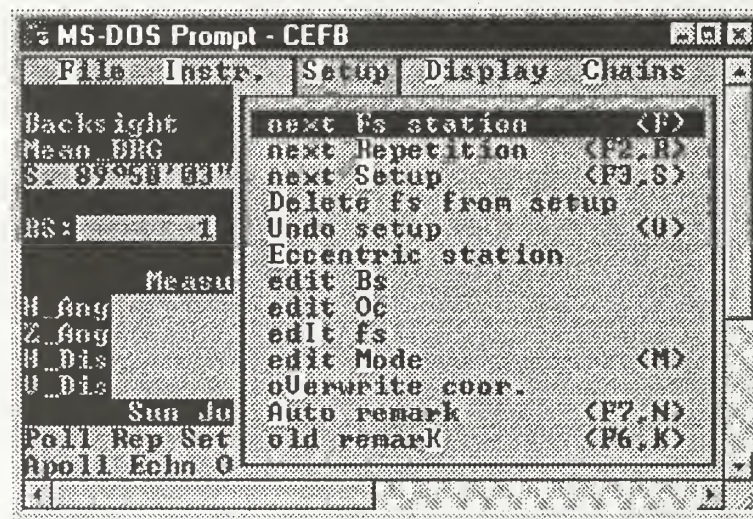


Figure 4.13: Survey Module Setup Menu

next Fs station

The 'next Fs station' function, or the **F** hot key, notifies CEFB to add another FS to the current repetition. When selected the operator will be prompted for the name of the new FS station and the HT, if the HI/HT prompt is on. After the appropriate data has been input, the survey data collection screen display will show the new FS station, and the FS# field will increment by one. Figure 4.14 displays the Next FS station prompt.

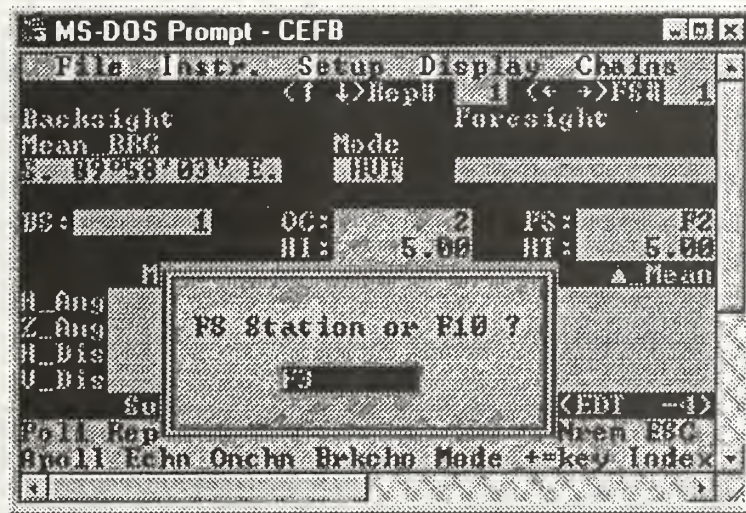


Figure 4.14: Next FS Station Prompt

The prompt in this window is "FS Station or F10 ?". This notifies the operators that an index file is currently loaded and the F10 key can be used here to specify the next FS station. The F10 of 'index list' function along with automatic point indexing is detailed in Chapter Nine. If there was not an index file currently loaded this prompt would be "FS Station ?". With station F3 accepted in the prompt in Figure 4.14, Figure 4.15 displays the resulting setup. Notice the FS# field has incremented to two.

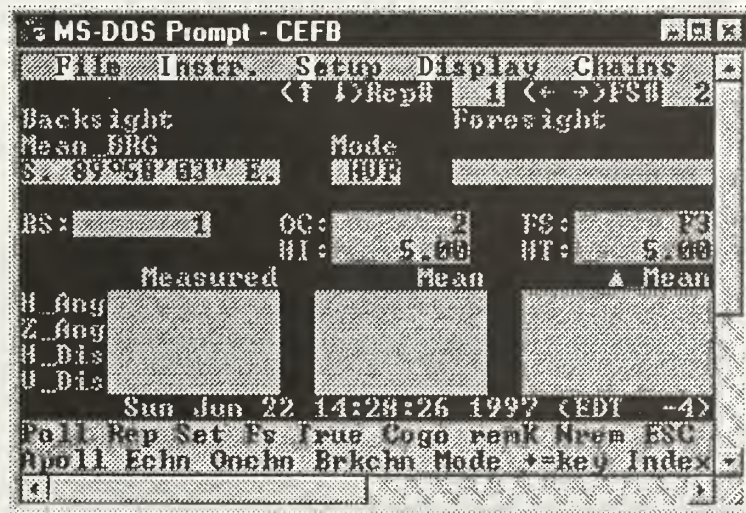


Figure 4.15: Resulting Next FS Station Setup

next Repetition

The 'next Repetition' function, or the **F2** or **R** hot keys, notifies CEFB to begin a new angular repetition. Every time the operator selects a new repetition, they must re-Back sight. This is an essential function when doubling an angle for example to a traverse station or property corner. CEFB assumes that the surveyor is repeating the observations to all of the foresights in the first repetition. Therefore the default station for the next repetition prompt will always be the first FS station of the first repetition. This, of course, is not always the case, but the default station can very easily be changed. Figure 4.16 displays the next repetition prompt after three FS stations (MFP1, MFP2, MFP3) were collected.

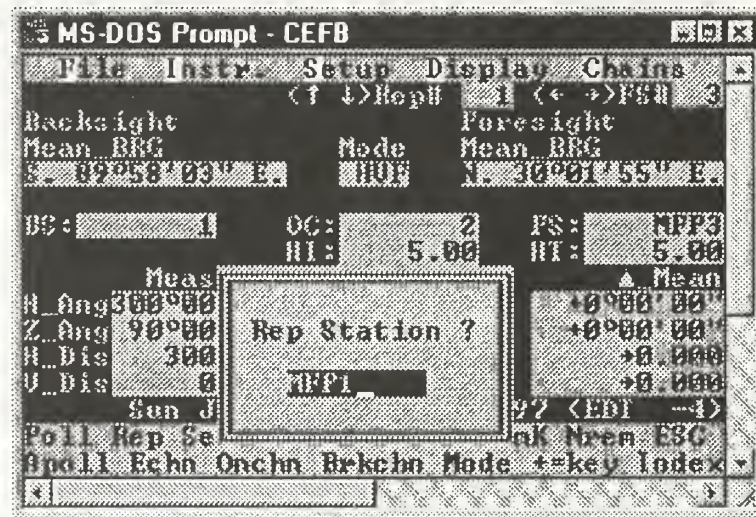


Figure 4.16: Next Repetition Prompt

With station **MFP1** accepted in the prompt in Figure 4.16, Figure 4.17 displays the resulting setup. Notice the Rep# field has incremented to two.

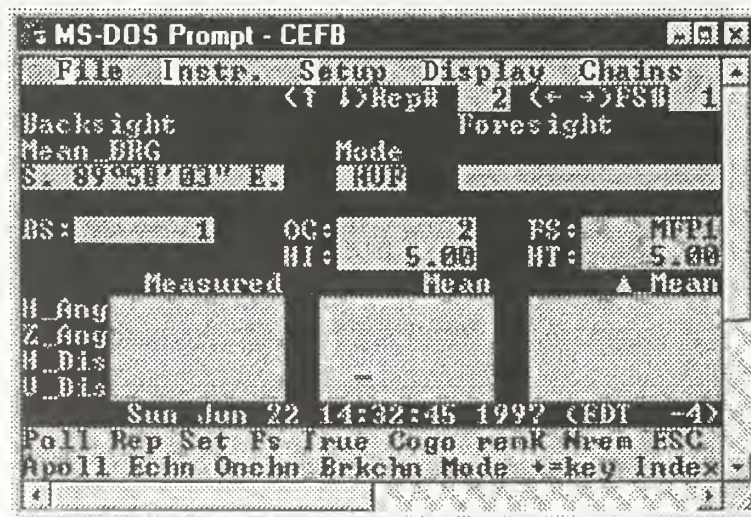


Figure 4.17: Resulting Next Repetition Setup

The surveyor can now proceed with the 'Poll' function to repeating the observation to **MFP1**. If the surveyor desires to create a new FS with the next FS station described above for the second repetition, CEFB will assume the surveyor is repeating the observation to the second FS of the first repetition. Therefore the default station for the 'next FS station' function after the setup in Figure 4.17 is observed is **MFP2** and is shown in Figure 4.18. This default station again can be altered very easily. CEFB will continue with this assumption until the number of foresights in the current repetition exceeds the number of foresights in the first repetition.

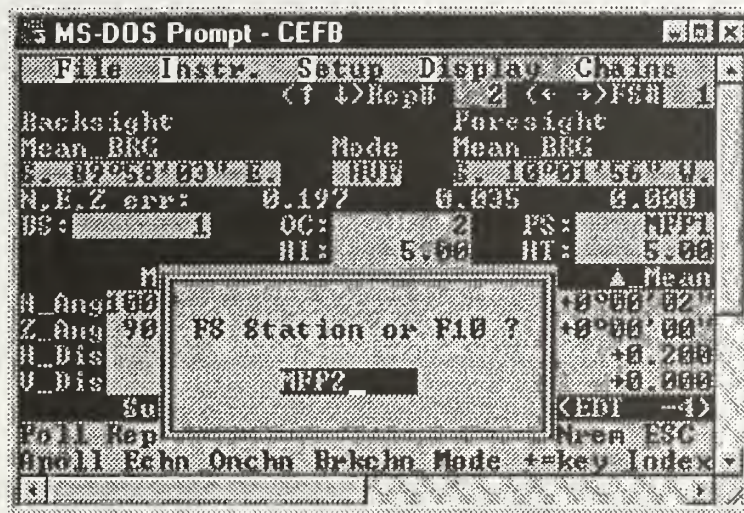


Figure 4.18: Next FS Station Prompt on 2nd Repetition

next Setup

The 'next Setup' function, or the F3 or S hot key, notifies CEFB to begin a new set up. Figure 4.19 displays the first prompt of the 'next Setup' function.

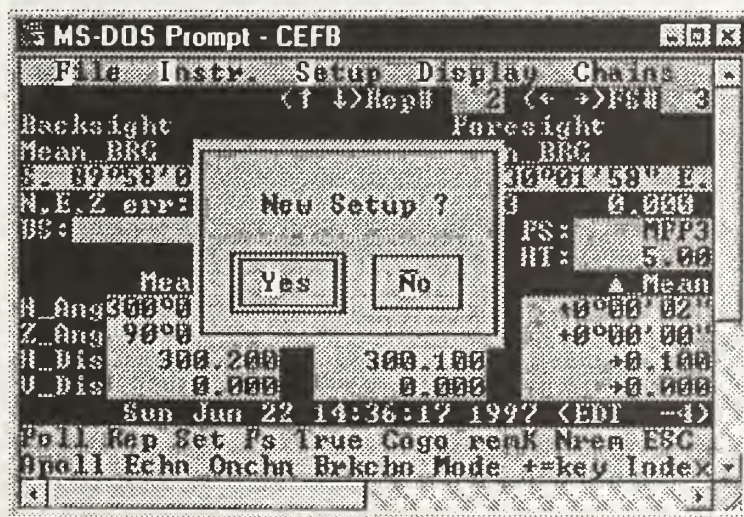


Figure 4.19: New Setup Prompt

If the prompt is accepted in Figure 4.19, data from the current setup is saved to the field (.ff) file, and then the prompt in Figure 4.20 is presented to the operator. If the prompt in Figure 4.19 is not accepted, the operator is returned to the current setup.

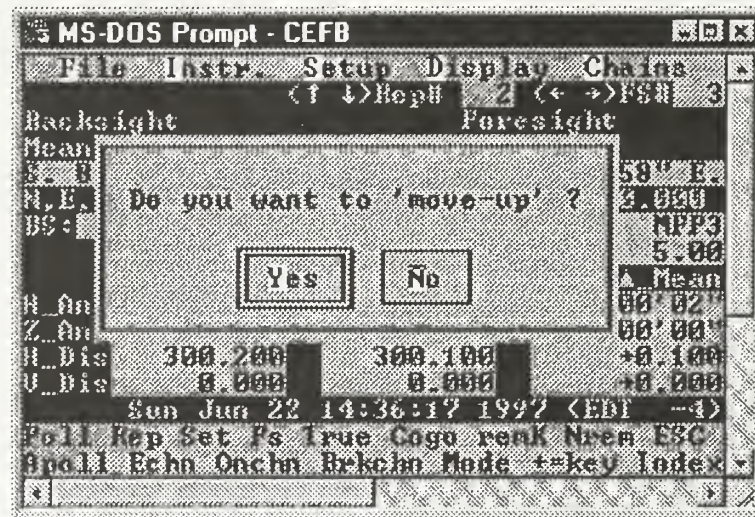


Figure 4.20: Move Up Prompt

The operator in Figure 4.20 is given the choice to create a new setup based on the current BS and OC stations, or to move the stations up where the current OC station automatically becomes the new BS, and the current FS automatically becomes the new OC station. Both options consequently then prompt the operator to define a new FS station and a new HT if applicable.

It is extremely important to remember that the 'new Setup' function is only function within the Survey Module which saves data to the field (.ff) file, other than the 'Quit' function. Whenever the 'new Setup' and 'Quit' functions are invoked, and there are least one observation in the current setup, data will automatically be save to the field (.ff) file. If no observation exist in the current setup, no data will be written. Also the move segment of the 'new Setup' function, as it applies to the index file, is detailed in Chapter Nine.

Delete fs from setup

The 'Delete fs from setup' function allows the operator to remove any FS station from the setup. When selected, the operator must confirm the removal of the FS station before it is actually accomplished. Any observation removed with this function will not appear in the field file and can not be edit with the Read/Edit Module. There will be no record, what-so-ever, of its existence. Figure 4.21 displays the prompt for the 'Delete fs from setup' function.

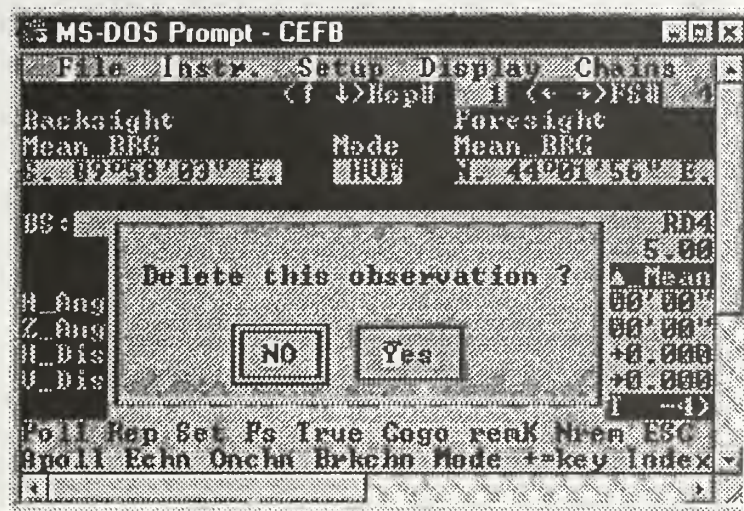


Figure 4.21: Delete FS From Setup

Figure 4.22 displays the results from accepting the prompt in Figure 4.21. Notice the FS# field has decreased to 3 and the prior observation is displayed.

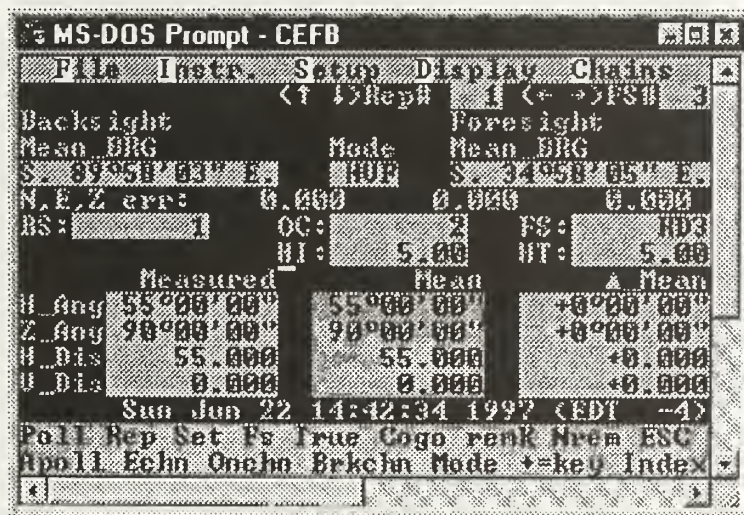


Figure 4.22: Delete FS From Setup Results

Undo setup

The 'new Setup' function discussed its procedure of automatically saving data to the field (.ff) file when there are current observations in the existing setup. There are situations when a surveyor does not want to save the data from a particular setup that contain measurements. The 'Undo setup' function, or the U hot key, performs exactly like the 'new Setup' function describe earlier in this section, except that surveyor is asked whether or not to save the current data after the "new setup" and "Do you want to'move up' ?" prompts. This prompt is shown in Figure 4.23.

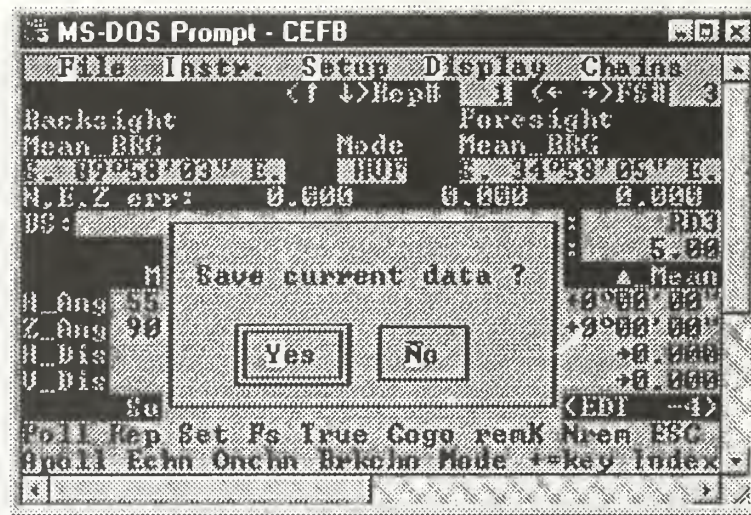


Figure 4.23: Save Current Data Prompt

Eccentric station

Eccentric positions are offset location of objects. Most of the time the center of these objects can not be occupied. The 'Eccentric station' function prompt is shown in Figure 4.24.

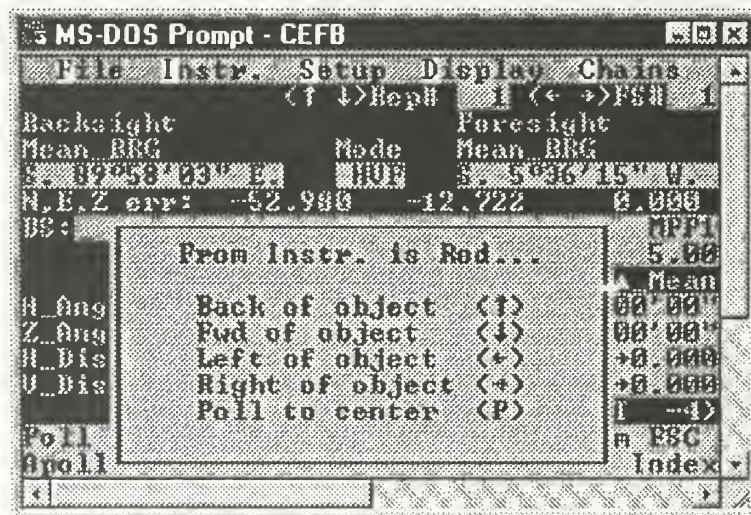


Figure 4.24: Eccentric Station Prompt

Back, Forward, Right, and Left Offsets

There are two methods to locate eccentric stations. One method is to define a rod offset to the center of the object being measured. The direction of the offset is defined by the position of the rod relative to the object being observed from the perspective of the instrument person. The four possible offset directions, **Back**, **Forward**, **Left**, and **Right**, can be invoked there corresponding arrow directions as shown in Figure 4.24. Offset direction definition is detailed in Figure 4.25.

Rod position
 B - Back
 F - Forward
 R - Right
 L - Left

⊗ - object (FS)
 △ - instrument

R
 B ⊗ F △
 L

Figure 4.25: Offsets Direction Definitions

Once the surveyor defines a offset direction, he or she must define the offset distance with the prompt shown in Figure 4.26. The prompt will always display the chosen offset direction and the defined horizontal unit.

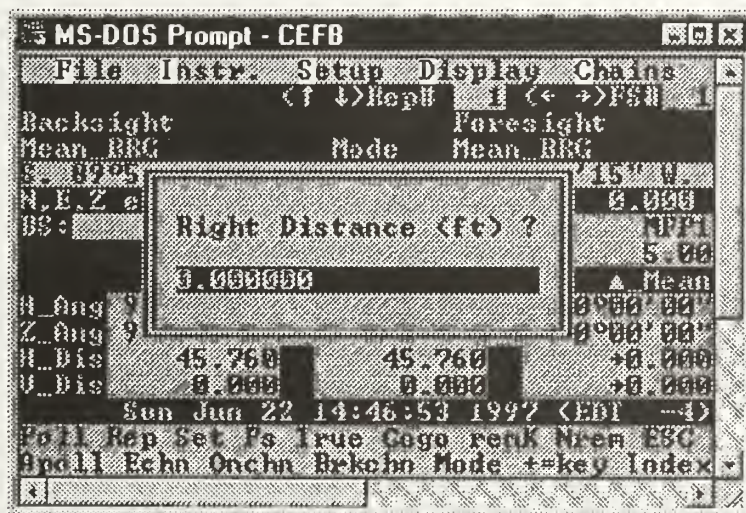


Figure 4.26: Offset Distance Prompt

This method of the 'Eccentric station' function can be performed directly before or after an observation. It must be, however, performed on each repetition of a eccentric station. For example, if a monument needed to be located eccentrically, and the surveyor desired to double the angle to the monument, the surveyor would need to perform the 'Eccentric station' function on both repetitions. CEFB will, however, remember the offset distance from the first repetition.

Eccentric information is used to calculate the coordinates of the center of the object in CEFB and TOLSA. The **Forward** and **Back** offsets distances are added and subtracted respectively to the distance shot to the rod to compute the center of the object.

The **Right** and **Left** offsets compute the center of the object by assuming the right angle to be at rod in the eccentric calculation. Coordinates are computed for the rod location, then a traverse cogo computation computes the object location based on the right angle assumption and the offset distance. The calculation is computed with this assumption because of the theory that it is easier to position the rod in the correct location by visualizing the right angle at the rod instead of at the object, which cannot be occupied and is difficult to visualize. Figure 4.27 illustrates this concept.

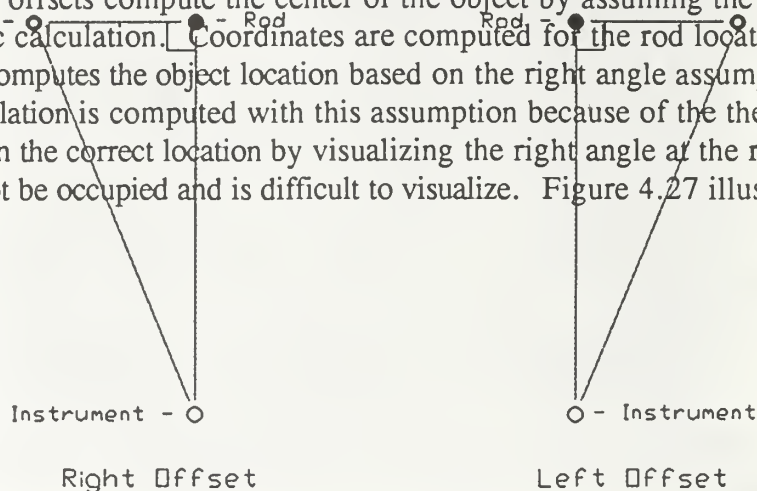


Figure 4.27: Right and Left Eccentric Computation

Surveyors using the "+" or "=" keys (described in Chapter Nine) with the Forward, Back, Right, and Left offset directions must perform the 'Eccentric station' function directly after the shot has been observed. This is because the observation structure or memory for the next consecutive FS station ID is not allocated until the "+" or "=" function has been initiated.

Poll to Center

The second method to locate eccentric stations is the Poll to center option on the last line of the prompt shown in Figure 4.24. This method of the 'Eccentric station' function is always performed directly after the rod is located. The rod is always going to be offset to the right of left, as described above, for this function. Once the rod is located, the operator would then sight the center of the object with the instrument then invoke the 'Eccentric station' function and hit P for Poll to Center in the prompt shown in Figure 4.24. This will record, in HV mode, the horizontal and vertical circle readings. This along with the observations to the rod location provide enough information to calculate the position of the center of the object. Figure 4.28 illustrates poll to center calculation.

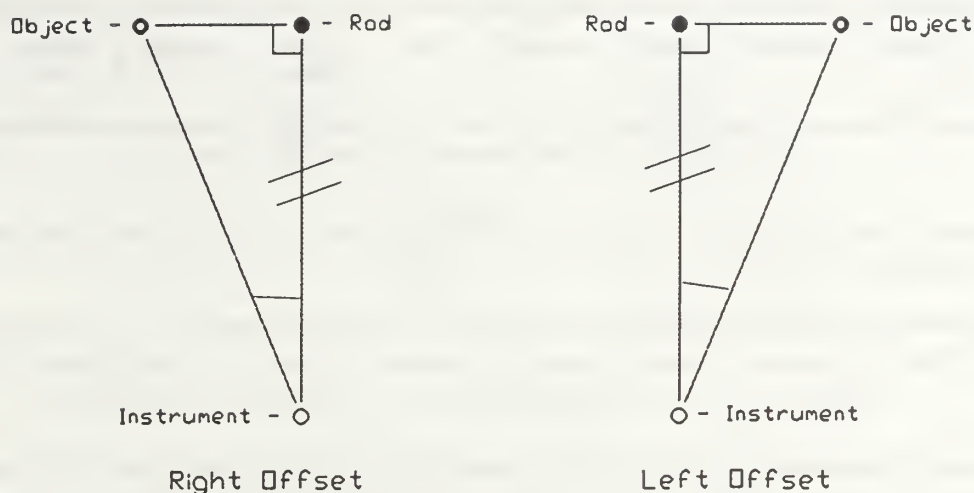


Figure 4.28: Poll to Center Computation

The direction, distance, and coordinates are computed to the center of the object with three pieces of information; the right angle assumption at the rod as discussed earlier, the distance to rod, and the interior angle between the object and rod. The interior angle is computed by the difference in horizontal circle readings between the object and rod. It is important to remember that the 'Eccentric station' function in CEFB can only compute coordinates for the center of the object if the BS and OC stations currently have coordinates in the coordinate (.cr) file.

How does CEFB and CMM Handle Eccentric Stations?

The observation file (.OBS) shown in Table 4.1 was generated from the CEFB field file (.FF) using the *FFTOOBS.EXE* program. This process is detailed in Chapter Two.

The first line of the .OBS file begins with the letter 'S'.

This line defines the setup: BS at station #1 OC at station #2

The second line begins with a 'B' and shows a back sighted circle reading of 0° 0' 0".

The lines following are the foresighted stations beginning with the letter 'F'. The eccentricity of the observations in this particular example are 10.0 feet for demonstration purposes.

S	1	2	0.000										Thu Jun 11 07:41:53 1997	
B	0	0	0.0											
F	OBJECT	1	0.000	180	0	0.0	90	0	0.0	1000.000	0.000	Thu Jun 11 07:42:10 1997		
F	FORWARD	1	0.000	180	0	0.0	90	0	0.0	990.000	F	10.000	Thu Jun 11 07:43:12 1997	
F	BACK	1	0.000	180	0	0.0	90	0	0.0	1010.000	B	10.000	Thu Jun 11 07:43:57 1997	
F	LEFT	1	0.000	179	25	37.4	90	0	0.0	1000.050	L	10.000	Thu Jun 11 07:44:57 1997	
F	RIGHT	1	0.000	180	34	22.6	90	0	0.0	1000.050	R	10.000	Thu Jun 11 07:45:53 1997	
F	POLL	1	0.000	180	0	0.0	90	0	0.0	1000.050		180.573	Thu Jun 11 07:45:53 1997	

Table 4.1: Eccentric Station (.Obs) File Format

The format of the (F) record for the four direction offsets is shown in Table 4.2.

identifier	station name	repetition #	height of target	horizontal Δ	zenith Δ	slope distance	eccentricity direction	eccentricity distance	time/date tag
F	LEFT	1	0.000	179 25 37.4	90 0 0.0	1000.05	L	10.000	Thu Jun 11 ...

Table 4.2: Offset Format for Foresight Records

The format of the (F) record for the poll to center option of the 'Eccentric station' function is shown in Table 4.3.

identifier	station name	repetition #	height of target	horizontal Δ to center of object	zenith Δ	slope distance	eccentricity direction	horizontal Δ to rod in decimal	time/date tag
F	POLL	1	0.000	180 0 0.0	90 0 0.0	1000.05	N/A	180.573	Thu Jun 11 ...

Table 4.3: Offset Format for Foresight Records

The OBJECT station was measured as a direct observation without eccentricity and shown to be $180^{\circ} 0' 0''$ and 1000' from the OC station. The other stations following OBJ are defined using the first eccentric method described above.

The FORWARD and BACK stations are both measured to be 180° as turned from the back sight. Notice that the FORWARD station is measured to be 990' which is 10' forward of the object, and the BACK station is measured to be 1010' which is 10' behind or in back of the object.

The LEFT and RIGHT stations vary angularly either less than or greater than 180° . Both distances are shown to be slightly larger than 1000' as expected.

The POLL station measured the rod to the right of the object. The horizontal angle to center of the object, and vertical angle and slope distance to the rod are the values shown in Table 4.3 for the poll to center option of the 'Eccentric station' function. The horizontal circle reading to the rod is placed in the offset distance field in decimal format.

Will TOLSA Produce the Same Location for these Observations?

To demonstrate that all of the eccentric measurements result in an identical location, we must look at how these measurements are handled by *TOLSA.EXE*.

The program *TOLSA.EXE* creates an .LSA file from the .OBS file. This process is discussed in detail in Chapter Two. One task *TOLSA.EXE* performs is to reduce the observations to their horizontal angle and distance components. If the eccentric stations measured above are correct, then they should all produce the same horizontal distance and angle to the object being located.

The first line(s) of the .LSA file contains the control station name(s) and coordinates. In this example there are no control points shown.

The following lines contain all of the measured distances and angles.

edit Oc

The 'edit Oc' function allows the operator to edit the currently displayed OC station and HI (if the HI/HT prompt is activate). There will be no record of the previous OC station in the field file. The prompt for this function is shown in Figure 4.30.

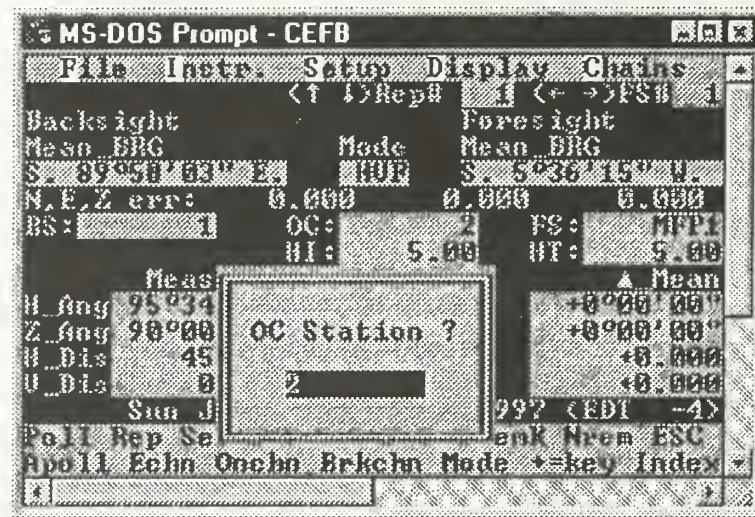


Figure 4.30: Edit OC Prompt

edit fs

The 'edit fs' function allows the operator to edit the currently displayed FS station and HT (if the HI/HT prompt is active). There will be no record of the previous FS station in the field file. The prompt for this function is shown in Figure 4.31.

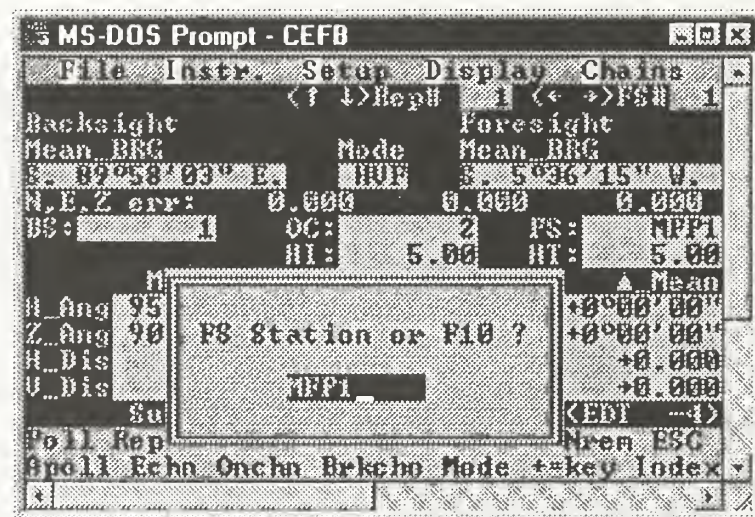


Figure 4.31: Edit FS Prompt

edit Mode

The 'edit Mode' function, or the **M** hot key, allows the surveyor to re-define the instrument measurement (EDM) mode. The default measurement mode is defined in the 'set Default values' function of the Main Module. The observation mode consists of a two or three character code. The three settings for the mode are **HVF**, **HVC**, and **HV**. The HV mode has no EDM and only records the Horizontal and Vertical plate readings. This is very useful when doing any sort of triangulation, and is also the default mode in the Astro Module. The HVF and HVC modes differs slightly for each instrument, but generally the HVC (coarse) takes only one EDM reading for a measurement, while the HVF (fine) take two or more EDM readings and then averages them for a measurement. The prompt for the 'edit Mode' function is shown in Figure 4.32.

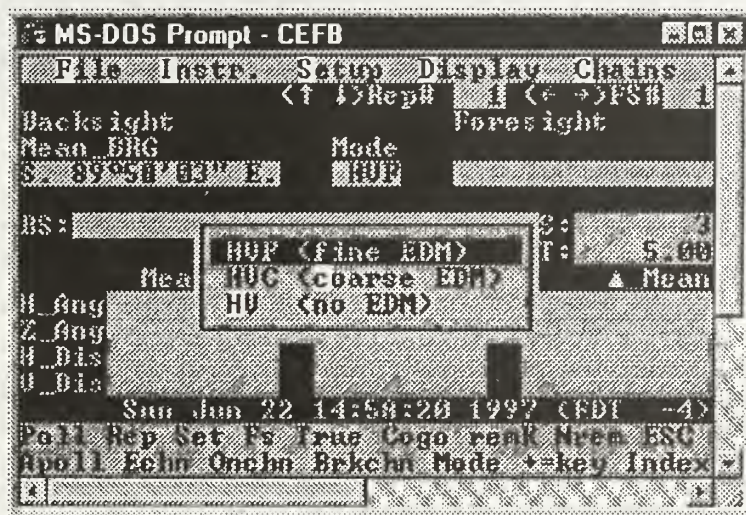


Figure 4.32: Measurement Mode Prompt

oVerwrite coor.

The 'oVerwrite coor.' function allows the surveyor to overwrite existing coordinates for the current FS station. This can be very useful when a surveyor realizes that the current FS station has a old or bad set of coordinates, and desires to overwrite them. This function would be evoked directly before or after the observation is taken to the FS station. The prompt for this function is shown in Figure 4.33. The retain option aborts this function, while the overwrite option replaces the existing coordinates.

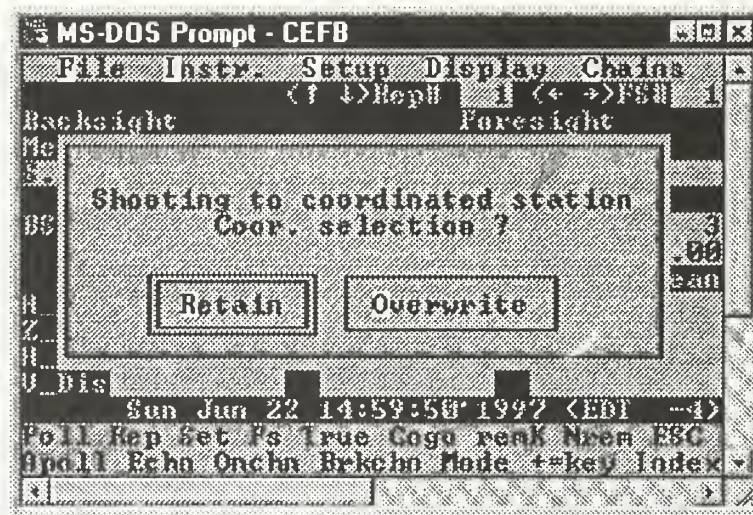


Figure 4.33: Overwrite Coordinate Prompt

Auto remark

The 'auto remark' function, or the F7 or N hot key, automatically executes the feature code corresponding to the FS station prefix and attaches it to that station. If there is not a corresponding identifier in the feature code file, or an acceptable index station ID in the FS station, the old remark function is executed. This function along with automatic point indexing is described in Chapter Nine.

old remarkK

The 'old remarkK' function, or the F6 or K hot key, displays a pick list of available feature codes in the feature code file. The surveyor must first, however, define the station to attached the description/remark to. This prompt is shown in Figure 4.34.

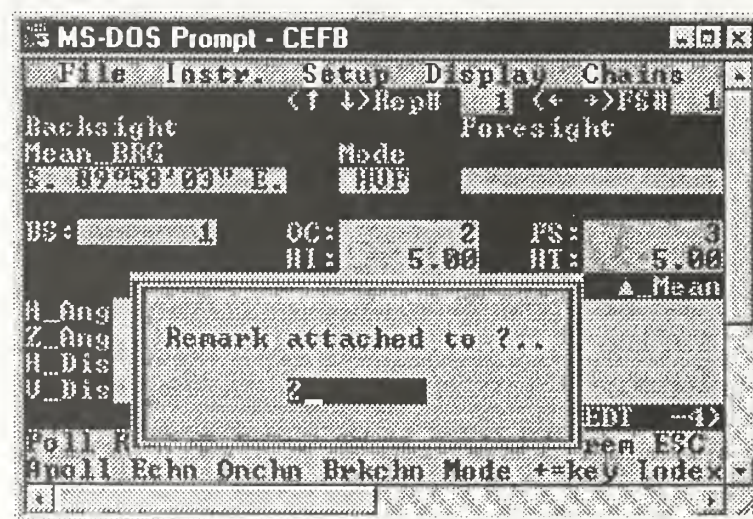


Figure 4.34: Attach Remark Prompt

The default station for this prompt can be defined in the 'set Default values' function in the Main Module (describe in Chapter Three). Figure 4.35 displays the pick list of available feature codes.



Figure 4.35: Feature Code Pick List

If the desired remark is not in the available feature codes, the survey can use the Escape (ESC) key, as shown at the top of the pick list, to enter a free from remark. The free form remark window is shown in Figure 4.36. The surveyor can enter as much information as he or she desires in the free form window. When the operator fills a window, the enter key will create another blank window for input. When the operator is finished the enter key on a blank window will end the remark.

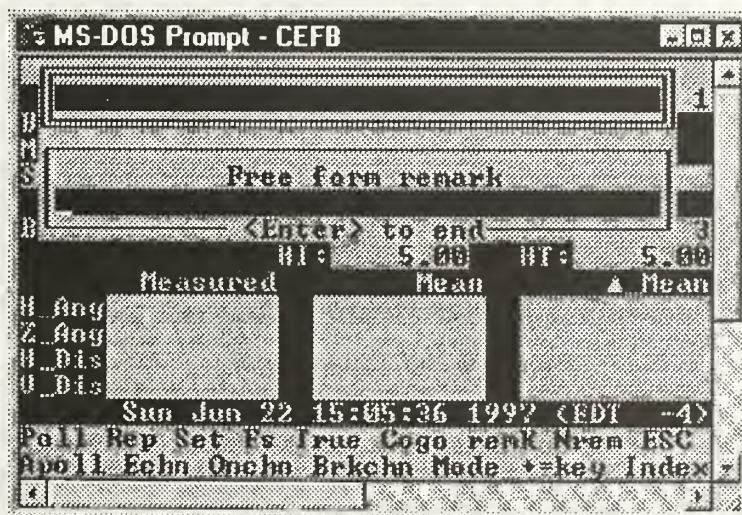


Figure 4.36: Free From Remark Window

Display Menu

The display menu has two functions which affect the display of data in CEFB. These functions have settings which are stored in CEFB's (.cf) configuration file. This menu is shown in Figure 4.37.

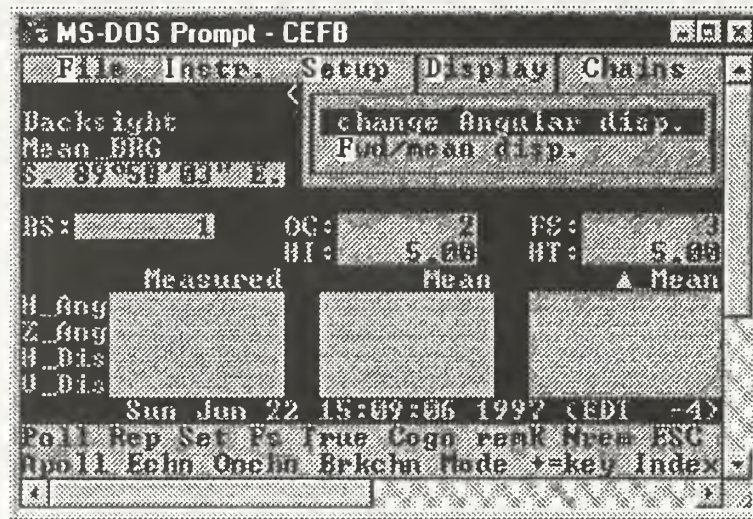


Figure 4.37: Survey Module

change Angular disp.

The 'change Angular disp.' function allows surveyors to define direction quantities displayed in CEFB as bearings or azimuths. All subsequent direction displays within CEFB will be affected. Examples of displays areas affected by this function are in the Cogo Module when inversing and intersecting, in the survey and Astro Module in the BS and FS direction field, and in the Trueline Module in the direction fields between stations. Figure 3.34 displays the change angular display prompt.

Fwd/mean disp.

The 'Fwd/mean display' function allows surveyors to define direction quantities displayed in CEFB while in geodetic mode as forward or mean bearings/azimuths. The fwd/mean display is only effective when in a geodetic environment. Examples of displays areas affected by this function are in the survey and Astro Module in the BS and FS direction field, and in the Trueline Module in the direction fields between stations. Figure 3.35 displays the fwd/mean display prompt.

Chains Menu

The chain menu contains function which pertain to the interactive collection of chains or line work in CEFB. The functions in this menu and chain collection in CEFB is discussed in detail in Chapter Ten. The chains menu is shown in Figure 10.1.

CHAPTER FIVE - CEFB - Astronomic (Astro) Module

Astronomic Computation Requirements

In order to compute astronomic azimuths in real-time, CEFB requires the following:

1. The SPCS Datum in CEFB must be set to a valid zone, so that latitude and longitude can be computed.
2. The latitude and longitude of the occupied station must be defined in the coordinate file.
3. The Greenwich hour angle, declination, and semi-diameter (if applicable) must be defined. This may be performed manually or automatically through the ephemeris (this is described in more detail later).
4. Correct system time and time zone settings.

Control Requirements

Requirements one and two assume that CEFB has access to the latitude and longitude of the occupied station. The computation of astronomic azimuth requires that this information be known. Control input can be performed by two methods:

1. The 'Input coord' function in the COGO Module.
2. The 'edit Data' function in the Astro Module.

Ephemeris

The third requirement has to do with the way in which CEFB acquires ephemeris information. In order to automate the interpolation process, a data file has been provided, which supplies digital ephemeris data for use in the interpolation process. This file must be named <year>.ep, where <year> is the current year in 4 decimal digits (e.g. 1998.EP). This data file consists of a line for each day of the year. Each line has the following information (in order and separated by spaces), shown in Table 5.1, for the 0 UTC hour of each day.

mm	Month of year (1-12).
dd	Day of month (1-31).
ddd.mmssss	Greenwich hour angle for the sun.
ddd.mmssss	Declination of the sun.
ddd.mmssss	Semi-diameter for the sun.
ddd.mmssss	Greenwich hour angle for polaris.
ddd.mmssss	Declination of polaris.

Table 5.1: Ephemeris File Data Structure

If the <year>.ep file exists in the default directory, CEFB will automatically retrieve the appropriate information for the time based on the computer's clock. If this file does not reside in the default directory CEFB requires that this ephemeris information be typed in manually. See the Edit data in the setup menu section in this Chapter.

Time Requirements

The last requirement deals with the system time and time zone settings in CEFB. Correct time is essential for accurate computation of astronomic observations. The 'set system Time' and the 'define timeZone' functions in the instrument menu of the Main Module (describe in Chapter Three) will accurately define these parameters for astronomic observations.

In the event that one of the requirements listed above is not fulfilled, CEFB will still collect observational field data for use in the post-processing program TOLSA.EXE. TOLSA.EXE will require the user to input the required astronomical information. All of the observational data collected by the astronomic data collection Module is saved in the .FF file.

Overview

A astronomic setup in CEFB is defined by the back sight station (BS), the occupied station (OC), the HI (if prompt turned on), and the foresight station (FS). The FS is going to be the stellar body being sighted. The surveyor is immediately prompted for these fields whenever the astronomic Module is invoked. The prompt the FS is a pick list containing, at this point, the sun or polaris for choices. This pick list is shown in Figure 5.1.

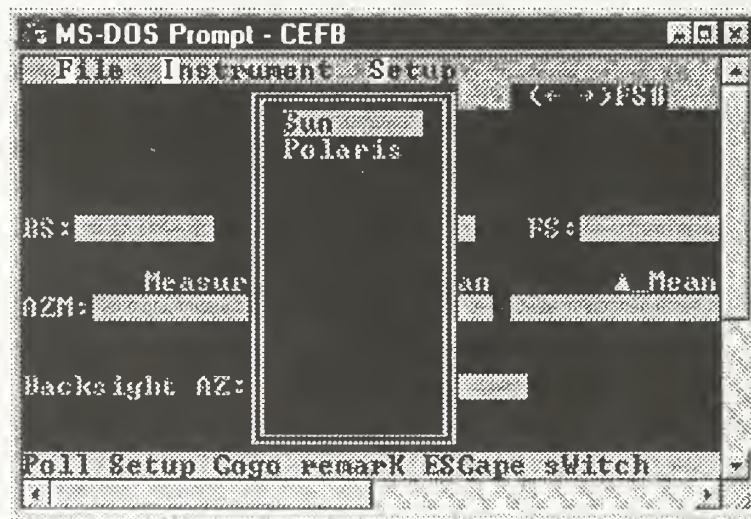


Figure 5.1: Celestial FS Prompt

After a selection is made in Figure 5.1, CEFB will attempt to read an ephemeris ('year'.ep) file in the CEFB default directory and automatically interpolate values for the Greenwich hour angles, declinations, and semi-diameters. If the surveyor selects the sun option in Figure 5.1, he or she must then define the position sighting of the sun. This prompt is shown in Figure 5.2.



Figure 5.2: Solar Position Sighting Prompt

The three options in Figure 5.2 define the exact position the instrument person will sight the sun with the cross hairs, and applies the appropriate semi-diameter correction to observations. This is important for accurate astronomic observation. Figure 5.3 illustrates the three options.

Figure 5.3: Solar Position Sighting Definitions

The main screen of the Astro Module shown in Figure 5.4 contains many of the same features as other screens in CEFB. The top line contains the pull-down menu bar, the third to the last line contains the current system time and date, and the hot key bar occupies on the bottom line. The area in between these lines is used to display information specific to the astronomic observations.

If the <year>.ep file exists in the default directory, CEFB will automatically retrieve the appropriate information for the time based on the computer's clock. If this file does not reside in the default directory CEFB requires that this ephemeris information be typed in manually. See the Edit data in the setup menu section in this Chapter.

Time Requirements

The last requirement deals with the system time and time zone settings in CEFB. Correct time is essential for accurate computation of astronomic observations. The 'set system Time' and the 'define timeZone' functions in the instrument menu of the Main Module (describe in Chapter Three) will accurately define these parameters for astronomic observations.

In the event that one of the requirements listed above is not fulfilled, CEFB will still collect observational field data for use in the post-processing program TOLSA.EXE. TOLSA.EXE will require the user to input the required astronomical information. All of the observational data collected by the astronomic data collection Module is saved in the .FF file.

Overview

A astronomic setup in CEFB is defined by the back sight station (BS), the occupied station (OC), the HI (if prompt turned on), and the foresight station (FS). The FS is going to be the stellar body being sighted. The surveyor is immediately prompted for these fields whenever the astronomic Module is invoked. The prompt the FS is a pick list containing, at this point, the sun or polaris for choices. This pick list is shown in Figure 5.1.

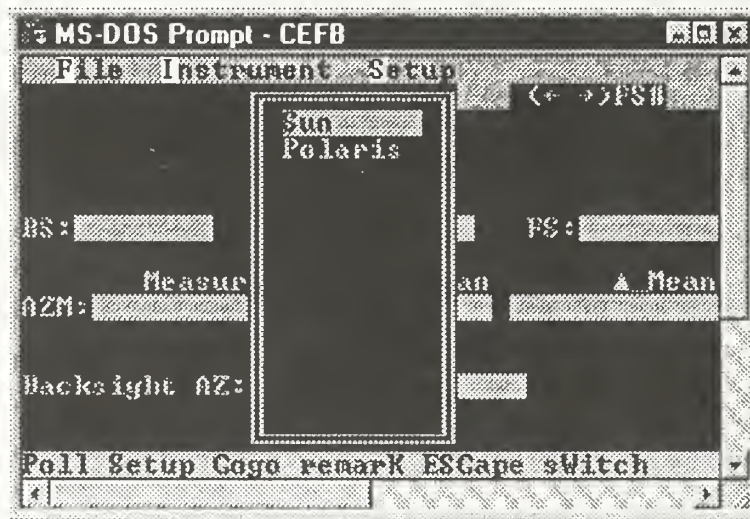


Figure 5.1: Celestial FS Prompt

After a selection is made in Figure 5.1, CEFB will attempt to read an ephemeris ('year'.ep) file in the CEFB default directory and automatically interpolate values for the Greenwich hour angles, declinations, and semi-diameters. If the surveyor selects the sun option in Figure 5.1, he or she must then define the position sighting of the sun. This prompt is shown in Figure 5.2.



Figure 5.2: Solar Position Sighting Prompt

The three options in Figure 5.2 define the exact position the instrument person will sight the sun with the cross hairs, and applies the appropriate semi-diameter correction to observations. This is important for accurate astronomic observation. Figure 5.3 illustrates the three options.

Figure 5.3: Solar Position Sighting Definitions

The main screen of the Astro Module shown in Figure 5.4 contains many of the same features as other screens in CEFB. The top line contains the pull-down menu bar, the third to the last line contains the current system time and date, and the hot key bar occupies on the bottom line. The area in between these lines is used to display information specific to the astronomic observations.

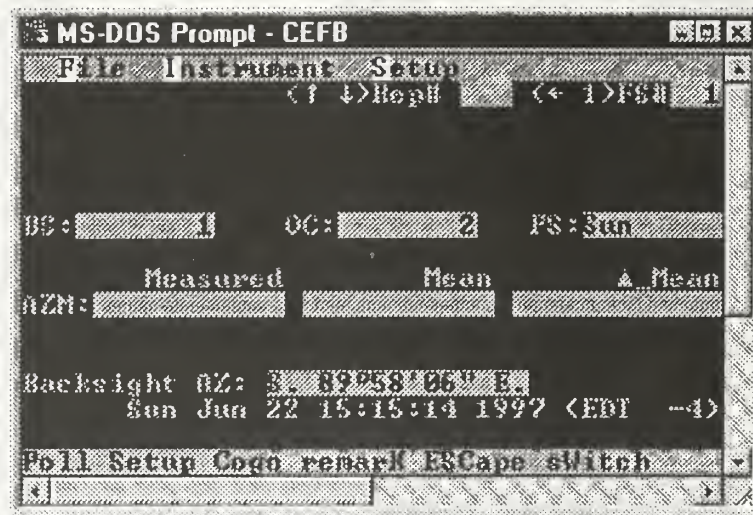


Figure 5.4: Astronomic Module

Displayed on the right side of the second line are the current repetition (Rep#) and foresight (FS#) numbers. The BS, OC, and FS information is displayed beneath the second line. Below this setup information is information on the current azimuth, the mean azimuth, the difference between current and mean azimuth, and the back sight azimuth.

All of the azimuths shown on the astronomic data collection screen refer to the computed forward azimuth *from* the occupied station *to* the back sighted station.

File Menu

The file menu functions are shown in Figure 5.5. All of these functions have been detailed in earlier sections. The **Cogo** function is discussed in the function menu section and the **Shell** and **Version** functions are discussed in the file menu section of Chapter Three (Main Module), while the **Quit** function is discussed in the file menu section of Chapter Four (Survey Module).

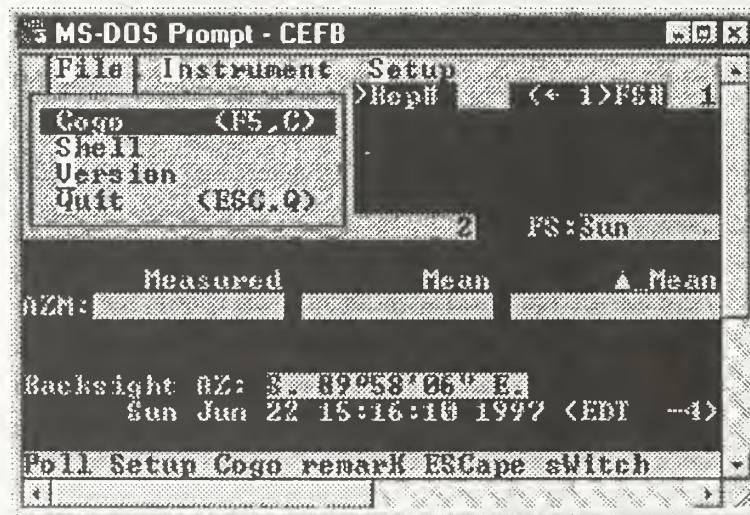


Figure 5.5: Astronomic Module File Menu

Instrument Menu

The instrument menu functions are shown in Figure 5.6. All the functions in this menu have been previously described in Chapter Four (Survey Module). For a description of the **Poll**, **Selection**, **Calibration**, and **Timeout** functions please refer to the instrument menu section in Chapter Four (Survey Module).

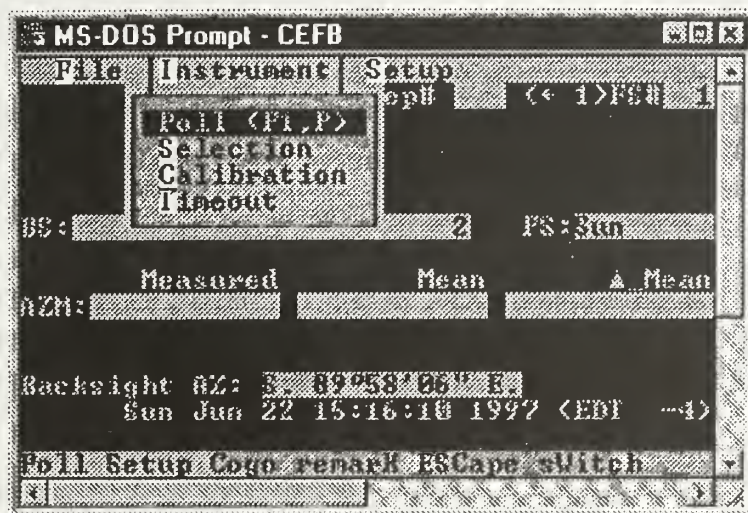


Figure 5.6: Astronomic Module Instrument Menu

Setup Menu

The Setup menu contains functions pertaining to setups, repetitions, station editing, and editing astronomic data. The setup menu is shown in Figure 5.7.

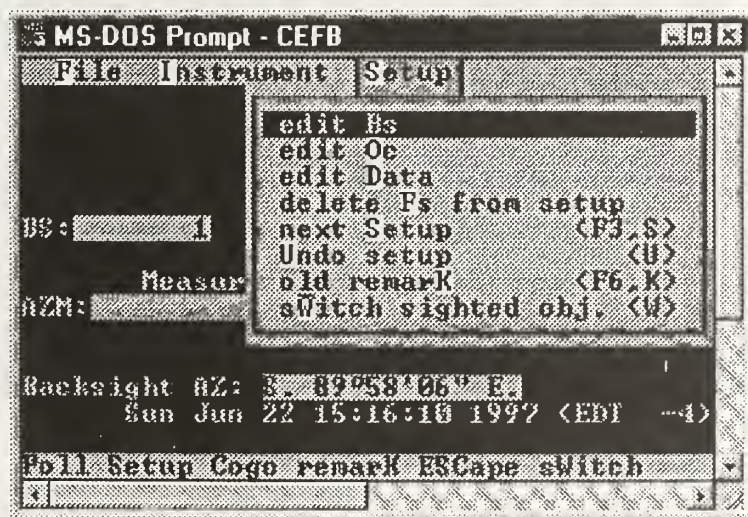


Figure 5.7: Astronomic Module Setup Menu

Edit Functions

The following edit functions may be performed either before or after an observation has been made for any given setup. These functions allow the user to edit the BS and/or OC stations for the current setup. If the desired observation has been saved to field file with the 'next Setup' function, the operator will have to utilize the Read/Edit Module (discussed in Chapter Eight) to edit the desired station.

edit Bs

The 'edit Bs' function allows the operator to edit the currently displayed BS station. There will be no record of the previous BS station in the field file. The prompt for this function is shown in Figure 4.29.

edit Oc

The 'edit Oc' function allows the operator to edit the currently displayed OC station and HI (if the HI/HT prompt is activate). There will be no record of the previous OC station in the field file. The prompt for this function is shown in Figure 4.30.

edit Data

The 'edit Data' function allows surveyors to manually input or edit most of the existing parameters which affect the computation of the azimuth. Manual entry may be desired if the ephemeris data ('year'.ep) file is not included within the CEFB default directory. Once selected, the screen shown in Figure 5.8 is displayed.

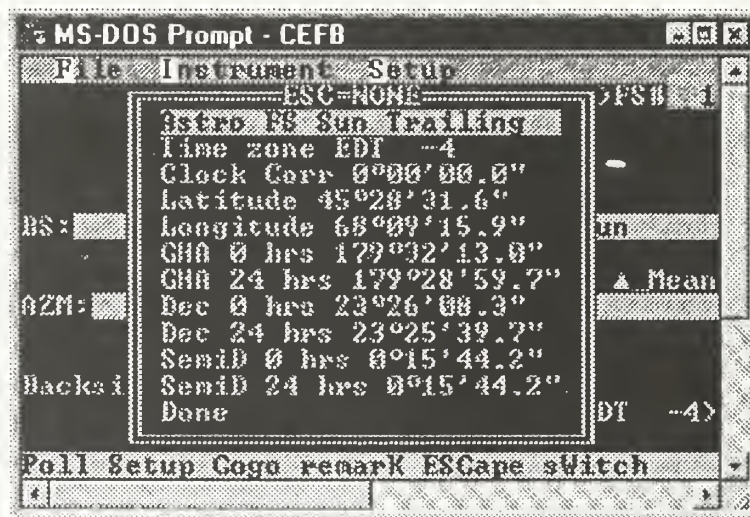


Figure 5.8: Edit Data Menu

All the values within the edit data menu are essential for the computation of an astronomic azimuths in real time. To edit one of the values in the pick list, the operator must highlight the desired choice, then simply hit the enter key. The operator will then be prompted with a edit window for the selected choice. The following is a description of each of the parameters in the edit data menu.

Astro FS

The Astro FS parameter identifies the stellar body being observed. The prompt the FS is a pick list containing, at this point, the sun or polaris for choices. This pick list is shown in Figure 5.1. Once a selection is made, CEFB will automatically interpolate values for the Greenwich hour angles, declinations, and semi-diameters (if applicable). If the SUN is selected, the operator is prompted for trailing edge, center, or leading edge in order to apply the appropriate semi-diameter correction, this prompt and the solar position sighting definitions are shown in Figure's 5.2 and 5.3 respectively.

Time zone

The Time zone option defines the time zone as it relates to the current system time. This function has been described in the options menu section of Chapter Three (Main Module).

Clock Corr

The clock corr option defines a clock correction factor, which is applied to every solar observation. Generally, it is easier to adjust the system time using the Set system time function described options menu section of Chapter Three (maine Module).

Latitude & Longitude

The Latitude and Longitude options define the latitude and longitude of the *occupied* station. These options should be defined if control for the occupied station does not exist within the coordinate (.cr) file.

Ephemeris Data

The GHA, DEC, and SemiD options allow new values for the Greenwich hour angle, declination, and semi-diameter of the appropriate stellar body to be observed. These three option both have a 0 and 24 hour value to facilitate correct interpolation of these values during observation time.

Done

The done option must be selected when one or more of the parameters have been defined or edited, and the operator wants to save the information. The Escape (ESC) key quits the edit data menu without saving any information.

delete Fs from setup

The 'delete Fs from setup' function allows the operator to remove any FS observation from the current setup. This function is described in detailed in the setup menu section of Chapter Four (Survey Module).

next Setup

The 'next Setup' function, or the **S** or **F3** hot key, allows the surveyor to create a new setup in the Astro Module. This function is described in detailed in the setup menu section of Chapter Four (Survey Module). This function, however, differs slightly from the next setup function in the Survey Module. The "Do you want to 'move up' ?", and the FS prompt do not appear. This is because operator would never want to move up of the stellar object, and the FS will always remain the chosen stellar while in the Astro Module. Data from the current setup is also always saved to the field (.ff) file during this function.

Undo setup

The 'Undo setup' function, or the **U** hot key, performs exactly like the new setup function describe earlier in this section, except that surveyor is asked whether or not to save the current data after the "New Setup?" prompt. This prompt is shown in Figure 4.23.

old remark

The 'old remark' function, or the **K** or **F6** hot key, displays a pick list of available feature codes in the feature code file. This function is described in detailed in the setup menu section of Chapter Four (Survey Module).

sWitch sighted obj.

The 'sWitch sighted obj.' function, or the **W** hot key, enables surveyors to define the BS or the stellar object as his or her next foresight. This assists in the correct station identification associated with observations records in the field (.ff) and observation (.obs) files, and facilitates correct post processing of the astronomic observations. The 'sWitch sighted obj.' function is applied after a surveyor has taken several observations of the chosen stellar object, and is prepared to close back to the BS. Figure 5.9 displays the prompt enabling the surveyor to turn to the BS as the sighted object. Once, for example, the operator selects the BS option, he or she can poll the BS to complete the astronomic observation.

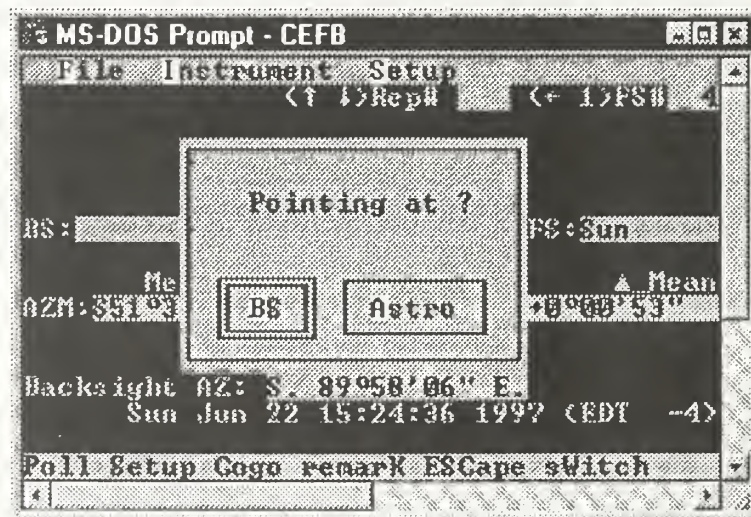


Figure 5.9: Switch Sighted Object Prompt

Astronomic Observation Checklist

1. Open field file and coord file.
2. Set/check system time.
3. Define time zone.
4. Define coordinate datum and SPCS zone.
5. Enter latitude & longitude of occupied station(s). This may also be performed from the Astro Module using the 'edit Data' function within the Setup pull-down Menu.
6. Define back sight, occupied, foresight.
7. Define solar position: trailing edge, center, or leading edge (if applicable).
8. Select the total station in use with the 'Selection' function in the Instrument pull-down menu.
9. Define ephemeris data if <year>.ep does not exist in the CEFB directory. This is done using the 'edit Data' function from the Setup pull-down menu within the Astro Module. See 'edit Data' function for other uses.
 - a. Greenwich Hour Angle at 0 hours
 - b. Greenwich Hour Angle at 24 hours
 - c. Declination at 0 hours
 - d. Declination at 24 hours
 - e. Semi diameter at 0 hours
 - f. Semi diameter at 24 hours

Typical astronomic observation steps using the Astro Module

1. Define all pertinent information. See check list above.
2. Sight the back sight and poll the instrument (P).
3. Sight the sun/star (using solar filter if applicable) and poll the instrument (P).
4. Wait for the time at the bottom of the CEFB screen to update.

NOTE: After an observation (Step 3), CEFB performs some computations. System time is not updated until these computations are completed. If the instrument is polled before system time has been updated, an incorrect time stamp will be recorded to that observation. This would result in an incorrect computation of the bearing/azimuth.

5. Repeat steps 3 & 4 until the desired number of direct observations are made.
6. Invert the scope of the instrument, sight the sun/star, and poll the instrument. Repeat this step until an equal number of indirect (reverse) observations are made.
7. Execute the 'sWitch sighted obj.' function with the **W** hot key, and select the **BS** option.
8. Sight the back sight and poll the instrument.

CHAPTER SIX - CEFB - Coordinate Geometry (Cogo) Module

Overview

The Cogo Module is where traditional coordinate geometry routines are performed. The main screen of the Cogo is shown in Figure 6.1.

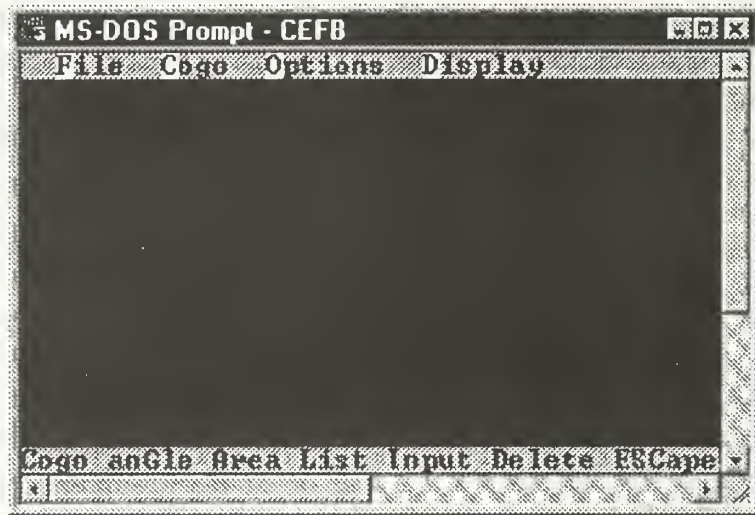


Figure 6.1: Cogo Module

The Cogo screen contains three basic sections: The pull-down menu bar which is located on the top line, the hot key bar located on the bottom line, and the display area in between. As information fills up the display area it will be scrolled upwards off the screen. This information can be re-displayed at any time the pull-down menu bar is active by pressing the up or down arrow keys, or by pressing the pageup (PgUp) or pagedown (PgDn) keys.

The Cogo Module requires that a coordinate file be defined before any computations will be initialized. Every coordinate computed is stored in the coordinate (.cr) file. It should be remembered that coordinates created in the Cogo Module are not transferable to CMM. However, a copy of the computations can be written to an ASCII log file for viewing with any text editor (See 'open log file' in the file menu section of this chapter).

The Cogo Module is a three dimensional coordinate geometry module. Whenever a new position is computed, it will require the input of an elevation for the new station. When computations are performed in a geodetic mode, the vertical component of each station is taken into consideration and utilized for the specific computation.

The Cogo Module operates in either a geodetic or a plane cartesian coordinate mode. The use of either of these modes is transparent to the operator. The determination of which mode is in use is a direct result of the defined coordinate datum.

File Menu

The file menu functions are shown in Figure 6.2. Three of these functions have been detailed in earlier sections. The **open Coord file**, **Shell**, and **Version** functions are discussed in the File Menu section of Chapter Three (Main Module).

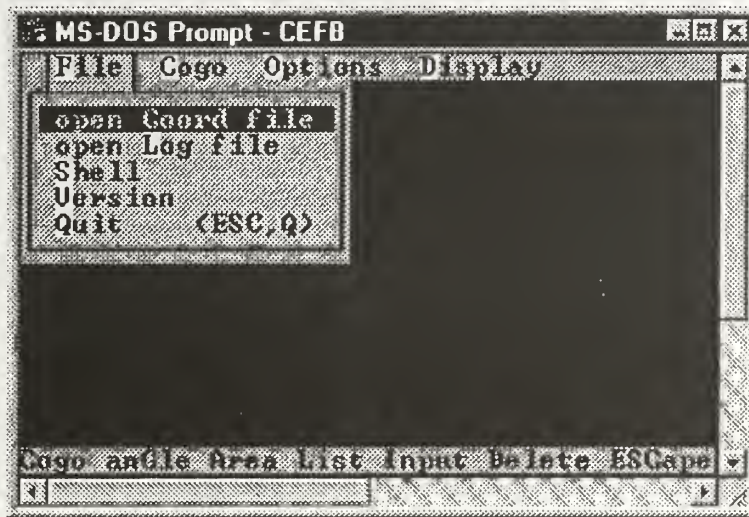


Figure 6.2: Cogo Module File Menu

open Log file

The 'open Log file' function allows a log file to be turned on or off during operations within the Cogo Module. A log file is an ASCII data file containing a verbatim copy of the information displayed during coordinate geometry computations. When selected, the user is prompted on the bottom line for the name of the Log file. This prompt is shown in Figure 6.3.

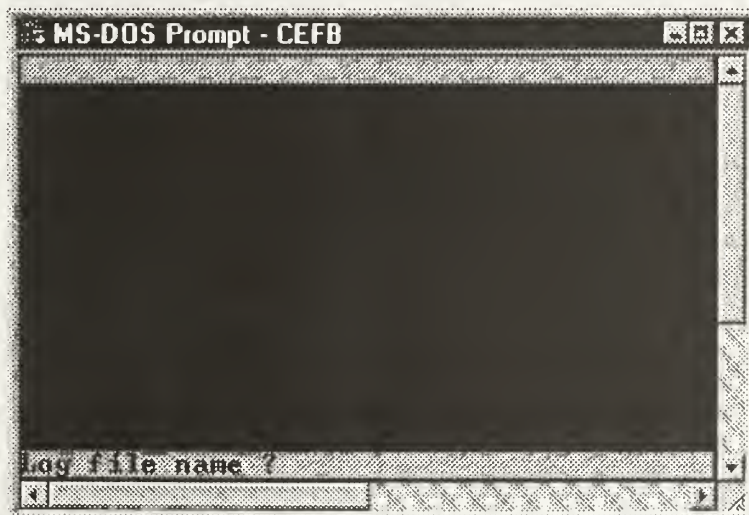


Figure 6.3: Define Log File Prompt

The surveyor can performed his or her desired computations. These computations will be written to the defined log file. When the surveyor is ready to close the log file, he or she must select the 'open Log file' function again. This will the invoke the prompt shown in Figure 6.4.

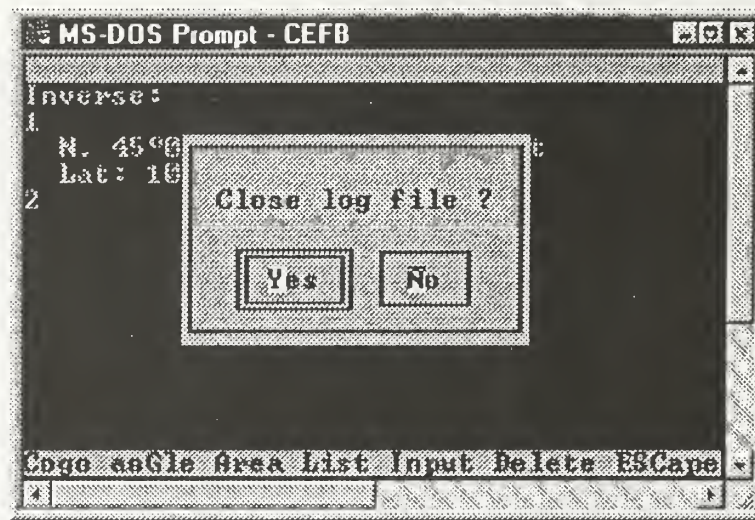


Figure 6.4: Close Log File Prompt

Below is a small example of a log file generated in the Cogo Module.

Mon Jun 09 11:55:24 1997 (EDT -4)

Bearing_Bearing:

3

N. 44°59'57" E. @ Elev. 103.41 ft

N. 45°00'00" E. 960.5894 ft

S. 45°00'03" W.

Lat: 679.2393 Dep: 679.2393

TEST

S. 45°00'03" E. @ Elev. 128.37 ft

S. 45°00'00" E. 880.2403 ft

N. 44°59'57" W.

Lat: -622.4239 Dep: 622.4239

1

Quit

The 'Quit' function, or the Q or ESC hot keys, quits the Cogo Module and returns the operator back to the module from which the Cogo Module was evoked. The Cogo Module may be activated from the Main and Survey Modules.

Cogo Menu

The functions available within the Cogo Menu are shown in Figure 6.5. These functions may be activated from the Cogo Menu, or more conveniently, from the hot key bar at the bottom of the screen.

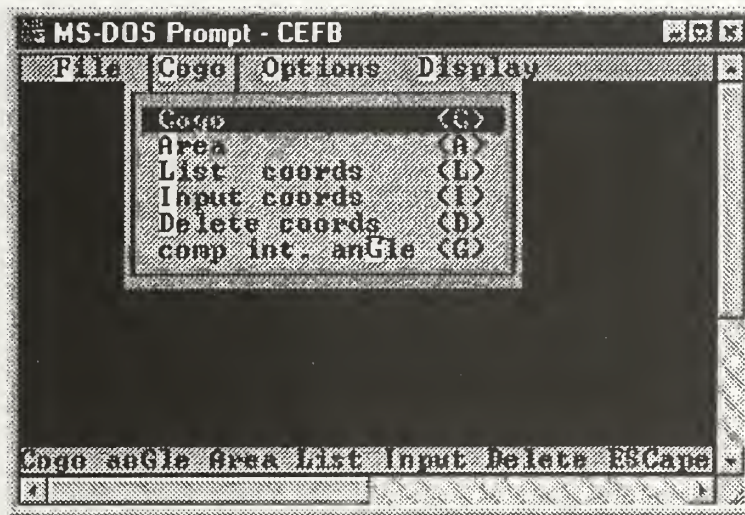


Figure 6.5: Cogo Module Cogo Menu

Cogo

The 'Cogo' function, or the **C** hot key, is where typical survey computations are performed (Inversing, Traversing, and Intersections). Figure 6.6 displays the initial screen of the 'Cogo' function.

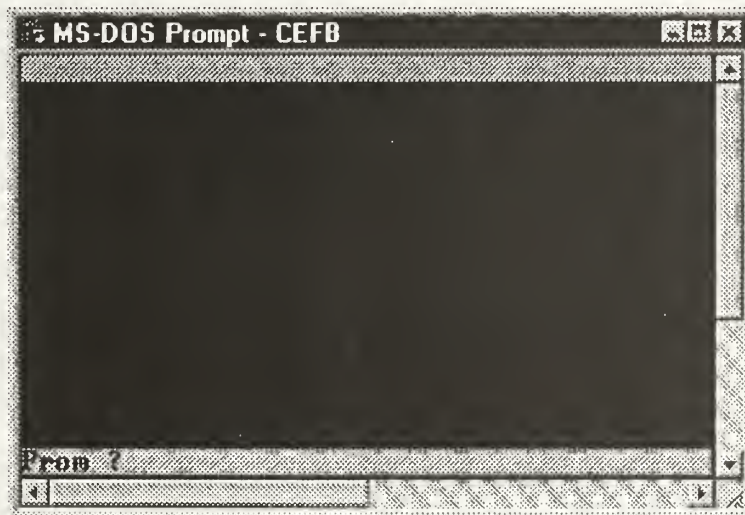


Figure 6.6: Cogo Function From Prompt

'From ?' is the always the first prompt of the 'Cogo' function shown in Figure 6.6. The bottom line in Figure 6.6 is the command line for all of the functions in the Cogo Menu. It is prompting for the beginning station in which the operator desires to proceed with Cogo computations. The 'Cogo' function requires that the initial 'From ?' station exist in CEFB's coordinate (.cr) file. If the operators enter a station name not in the coordinate (.cr) file, he or she will be presented with the prompt in Figure 6.7.

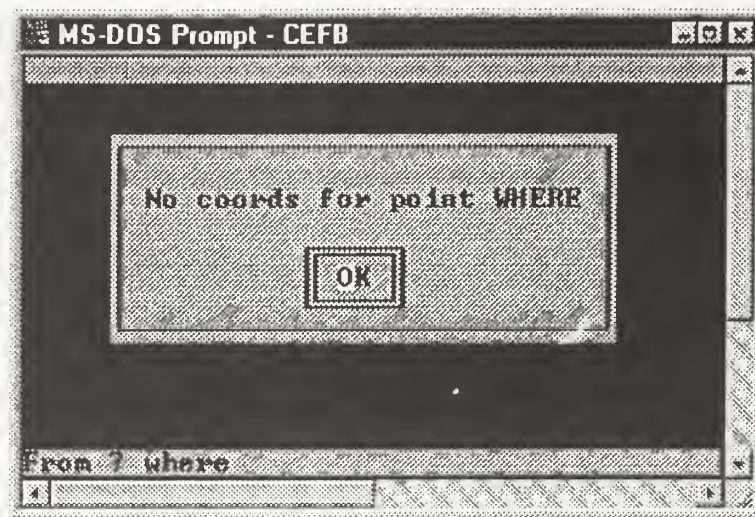


Figure 6.7: No Coords for Point Notice

Once the operator is notified with the prompt shown in Figure 6.7, He or she is returned to the 'From ?' prompt shown in Figure 6.6. This functionality applies to all Cogo Menu functions requiring input of a existing station ID.

Cogo Computations

The following sections describe the steps required to perform the three main types of Cogo computations (Inversing, Traversing, and Intersections). These functions can always be exited with the <Esc> or <Enter> keys until the pull-down menu bar appears. Figure's will not be shown in this section because the only major change between prompts occurs on the command line. The prompts on the command line are discussed in detail. Solutions are displayed to the screen once enough information has been entered

Inversing

1. Answer the initial *From ?* command line with an existing station ID. Ex.: **STA1**
2. Answer the *Brg.?* command line with the <Enter> key.
3. Answer the *Dist. <ft.>?* command line with the <Enter> key.

Note: The value between the < > brackets in step three will always display the defined output unit (Feet (ft.), International Feet (if.), Meters (m.), or Chains (ch.)).

4. Answer the *To ?* command line with an existing station ID. Ex.: **STA2**
5. The result of the inverse will be presented to the display area of the Cogo Module. Figure 6.8 shows two examples of the inverses between stations **STA1** and **STA2**. One example is in geodetic mode, while the other is in plane mode.

Note: Considering the example of the inverse between stations **STA1** and **STA2**, after steps 4 and 5, the command line will return to step 1. However, *From* **<STA2> ?** will now be in the command line. The **<STA2>** signifies that the operator can use the **<Enter>** key to accept **STA2** as the *From* station for the next inverse. This functionality facilitates the inverting of stations in a traversing fashion. An example of this is inverting from stations **STA1** to **STA2**, then **STA2** to **STA3**, then **STA3** to **STA4**, etc.

Inverse: STA1 S. 89°18'59" W. @ Elev. 152.84 ft S. 89°18'58" W. 434.3893 ft N. 89°18'56" E. Lat: -5.1858 Dep: -434.3583 STA2	Inverse: STA1 S. 89°47'07" W. 434.3880 ft Lat: -1.6270 Dep: -434.3850 STA2
---	---

Geodetic Mode

Plane mode

Figure 6.8: Inverting Examples

Cogo computations always display a header detailing the type of computation ('Inverse:' for the example in Figure 6.8) in the display area. Most of the information in Figure 6.8 is self-explanatory. The stations are above and below the data. In the geodetic example, the three bearings are the Forward, Mean, and Back geodetic bearings/azimuth respectively. The elevation is also shown in the geodetic example. The elevation value is the mean between the elevations of the two defined inverse stations. The distance (ground for geodetic, and grid for plane), with the defined output unit, along with the Latitude (Lat:) and Departure (Dep:) are also shown in both inverses. The Latitude is the difference in northing, while the Departure is the difference in easting between the two defined stations.

Traversing

1. Answer the initial *From* **?command** line with an existing station ID. Ex.: **STA1**
2. The command line should now read: *Brg.* **?**
3. Enter the bearing using the format: quadrant **<space>** bearing.
For example the bearing S 45°30'15" E would be: **2 45.3015**.

Quadrants: NE = 1 SE = 2 SW = 3 NW = 4

- 3a. If in geodetic mode, the command line should now read: *Forward (F) or mean(M)* **?..<M>**. Press **<Enter>** or **M** if you desire a mean geodetic bearing/azimuth, or the letter **F**, and **<Enter>** for a forward geodetic bearing. Ex. **M** for Mean
4. Answer the *Dist.* **<ft.> ?** command line with the desired distance and the **<Enter>** key. Ex.: **123.45**
- 4a. The operator can define a new output unit at the *Dist.* **<ft.> ?** prompt by inputting a distance followed by the desired output unit. Format: Distance **<space>** units. Two examples of this are **100.00 ch** or **100.00 m**. This functionality redefines the output unit, and therefore subsequent computations will assume the newly defined unit. If no units are specified, CEFB uses the units previously defined..

5. Answer the *New Pt. ?* command line with the desired new station. Ex.: **NEWPT1**
6. Answer the *New Elev. ?.. Default* command line. Where the **Default** is the elevation of the initial station. The operator can hit <Enter> to accept the default or enter a new elevation. Ex.: **NEWPT1**
- 6a. If the station entered in step 5, already exists in the defined coordinate (.cr) file, the operator will be presented with the prompt shown in Figure 6.9 after step six.

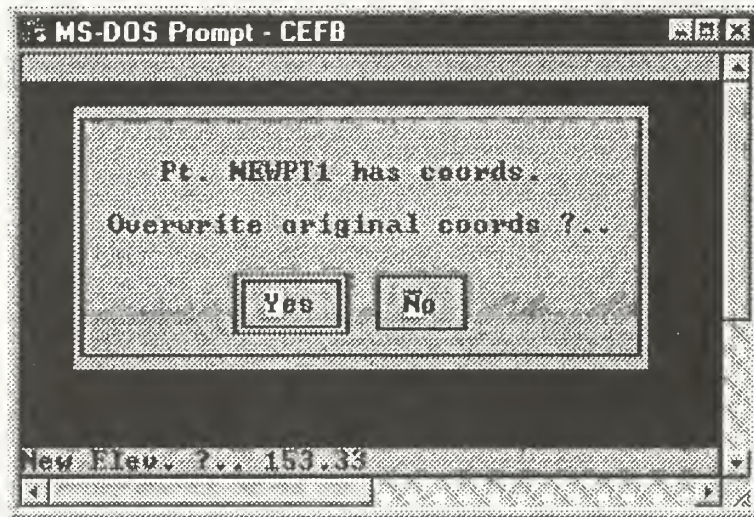


Figure 6.9: Existing Coordinates Overwrite Prompt

7. The results are presented to the display area. The command line will return to the *From <Previous To Station> ?* prompt, and the coordinates of the new station will be stored in the coordinate (.cr) file. Figure 6.10 shows two examples of the traversing to set station **NEWPT1** from **STA1**. One example is in geodetic mode, while the other is in plane mode.

Traverse:
 STA1
 S. 45°30'15" E. @ Elev. 153.33 ft
 S. 45°30'15" E. 123.4500 ft
 N. 45°30'15" W.
 Lat: -86.5208 Dep: 88.0571
 NEWPT1

Geodetic Mode

Traverse:
 STA1
 S. 45°30'15" E. 123.4500 ft
 Lat: -86.5208 Dep: 88.0571
 NEWPT1

Plane Mode

Figure 6.10: Traversing Example

Bearing-Bearing Intersections

1. Answer the initial *From ?* command line with the first existing station ID. Ex.: STA1
2. Answer the *Brg.?* command line with the first bearing. Ex.: N. 45°30'15" W. or 4 45.3015
- 2a. If in geodetic mode, the command line should now read: *Forward (F) or mean(M) ?..<M>*. Press <Enter> or M if you desire a mean geodetic bearing/azimuth, or the letter F, and <Enter> for a forward geodetic bearing. Ex. M for Mean
3. Answer the *Dist. <ft.> ?* command line with the <Enter> key.
4. Answer the *New Pt. ?* command line with the desired new station. Ex.: NEWPT1
5. Answer the *New Elev. ?.. Default* command line. Where the **Default** is the elevation of the initial station. The operator can hit <Enter> to accept the default or enter a new elevation. Ex.: NEWPT2
6. Answer the *From #2 ?* command line with the second existing station ID. Ex.: STA2
7. Answer the *Brg.?* command line with the second bearing. Ex.: N. 55°20'30" E. or 1 55.2030
- 7a. If in geodetic mode, the command line should now read: *Forward (F) or mean(M) ?..<M>*. Press <Enter> or M if you desire a mean geodetic bearing/azimuth, or the letter F, and <Enter> for a forward geodetic bearing. Example: M for Mean
8. The results are presented to the display area. The command line will return to the *From <Previous To Station> ?* prompt, and the coordinates of the new station will be stored in the coordinate (.cr) file. Figure 6.11 shows two examples of a bearing-bearing intersection to set station NEWPT2 from STA1 and STA2. One example is in geodetic mode, while the other is in plane mode.

```
Bearing_Bearing:
STA1
  N. 45°30'14" W. @ Elev. 153.33 ft
  N. 45°30'15" W. 247.1601 ft
  S. 45°30'16" E.
  Lat: 173.2240 Dep: -176.2997
NEWPT2
  S. 55°20'31" W. @ Elev. 152.84 ft
  S. 55°20'30" W. 313.7253 ft
  N. 55°20'29" E.
  Lat: -178.4097 Dep: -258.0572
STA2
```

Geodetic Mode

```
Bearing_Bearing:
STA1
  N. 45°30'15" W. 250.1570 ft
  Lat: 175.3243 Dep: -178.4373
NEWPT2
  S. 55°20'30" W. 311.1607 ft
  Lat: -176.9513 Dep: -255.9477
STA2
```

Plane Mode

Figure 6.11: Bearing-Bearing Intersection Example

Bearing-Distance Intersection

1. Answer the initial **From ?** command line with the first existing station ID. Example: **STA1**
2. Answer the **Brg.?** command line with the first bearing. Example: **N. 45°30'15" W.** or **4 45.3015**
- 2a. If in geodetic mode, the command line should now read: **Forward (F) or mean(M) ?.. <M>**. Press <Enter> or **M** if you desire a mean geodetic bearing/azimuth, or the letter **F**, and <Enter> for a forward geodetic bearing. Example: **M** for Mean
3. Answer the **Dist. <ft.>?** command line with the <Enter> key.
4. Answer the **New Pt. ?** command line with the desired new station. Example: **NEWPT1**
5. Answer the **New Elev. ?.. Default** command line. Where the **Default** is the elevation of the initial station. The operator can hit <Enter> to accept the default or enter a new elevation. Example: **NEWPT2**
6. Answer the **From #2 ?** command line with the second existing station ID. Example: **STA2**
7. Answer the **Brg.?** command line with the <Enter> key.
8. Answer the **Dist. <ft.>?** command line with the desired distance. Example: **400.00 ft.**
9. Select the desired solution from the prompt presented to the operator as shown in Figure 6.12. Figure 6.12 displays a easterly or westerly solution. A northerly or southerly prompt can also be presented to the operator. This prompt depends on the location of the two solutions.

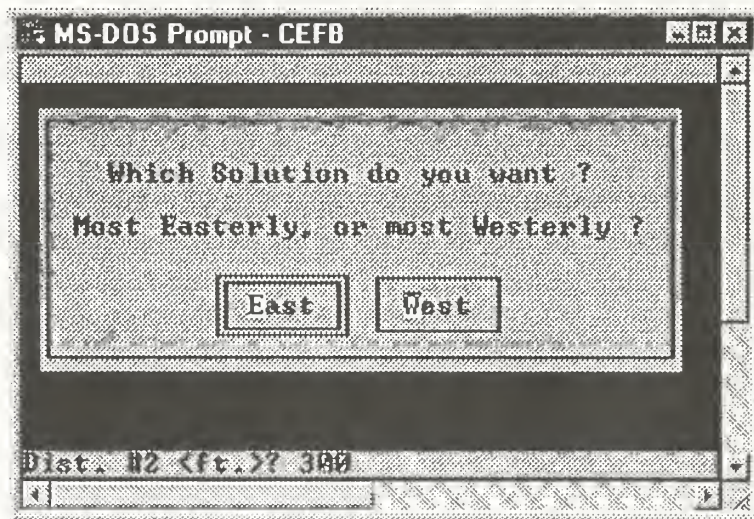


Figure 6.12: Which Solution do you want

10. The results are presented to the display area. The command line will return to the **From <Previous To Station> ?** prompt, and the coordinates of the new station will be stored in the coordinate (.cr) file. Figure 6.13 shows two examples of the westerly solution of a bearing-distance intersection to set station **NEWPT2** from **STA1** and **STA2**. One example is in geodetic mode, while the other is in plane mode.

Bearing_Distance:
 STA1
 N. 45°30'13" W. @ Elev. 153.33 ft
 N. 45°30'15" W. 561.2644 ft
 S. 45°30'17" E.
 Lat: 393.3663 Dep: -400.3507
 NEWPT2
 S. 4°52'36" W. @ Elev. 152.84 ft
 S. 4°52'36" W. 400.0000 ft
 N. 4°52'36" E.
 Lat: -398.5520 Dep: -34.0043
 STA2

Bearing_Distance:
 STA1
 N. 45°30'15" W. 566.7907 ft
 Lat: 397.2395 Dep: -404.2926
 NEWPT2
 S. 4°18'52" W. 400.0000 ft
 Lat: -398.8665 Dep: -30.0924
 STA2

Geodetic Mode

Plane Mode

Figure 6.13: Bearing-Distance Intersection Example

Distance-Distance Intersection

1. Answer the initial *From* ? command line with the first existing station ID. Example: STA1
2. Answer the *Brg.*? command line with the <Enter> key.
3. Answer the *Dist.* <ft.> ? command line with the first desired distance. Example: 400.00
4. Answer the *New Pt.* ? command line with the desired new station. Example: NEWPT1
5. Answer the *New Elev.* ?.. **Default** command line. Where the **Default** is the elevation of the initial station. The operator can hit <Enter> to accept the default or enter a new elevation. Example: NEWPT2
6. Answer the *From #2* ? command line with the second existing station ID. Example: STA2
7. Answer the *Brg.*? command line with the <Enter> key.
8. Answer the *Dist.* <ft.> ? command line with the second desired distance. Example: 400.00
9. Select a choice in the prompt shown in Figure 6.12 for the desired solution.
10. The results are presented to the display area. The command line will return to the *From* <Previous To Station> ? prompt, and the coordinates of the new station will be stored in the coordinate (.cr) file. Figure 6.14 shows two examples of the northerly solution of a distance-distance intersection to set station NEWPT2 from STA1 and STA2. One example is in geodetic mode, while the other is in plane mode.

Distance_Distance:
 STA1
 N. 33°34'15" W. @ Elev. 153.33 ft
 N. 33°34'15" W. 400.0000 ft
 S. 33°34'16" E.
 Lat: 333.2807 Dep: -221.1877
 NEWPT2
 S. 32°12'11" W. @ Elev. 152.84 ft
 S. 32°12'11" W. 400.0000 ft
 N. 32°12'010" E.
 Lat: -338.4664 Dep: -213.1678
 STA2

Distance_Distance:
 STA1
 N. 33°06'06" W. 400.0000 ft
 Lat: 335.0811 Dep: -218.4506
 NEWPT2
 S. 32°40'21" W. 400.0000 ft
 Lat: -336.7081 Dep: -215.9344
 STA2

Geodetic Mode

Plane Mode

Figure 6.14: Distance-Distance Intersection Example

Area

The 'Area' function, or the **A** hot key, performs an area computation based on a series of stations. Below are the steps to compute an area for a series of stations.

1. Answer the initial *From Station ?* command line with the first existing station ID.
2. Answer the *Next Station ?* command line with the next existing station ID.
3. Repeated step two as many times as desired. Inverses will appear in the display area as the operator enters stations. When ready to close back upon the initial station and compute an area, enter the first initial station in step two.

If in geodetic mode, three different areas are displayed: plane (grid) area, the area scaled to sea level, and the area scaled to a mean elevation of all the stations. If in plane mode, only the plane (grid) area will be computed. This function can be exited any time by pressing the <Esc> or <Enter> keys until the pull-down menu bar appears.

Figure 6.15 shows two examples of Area computations. One example is in geodetic mode, while the other is in plane mode. Both examples compute the area between stations **COR1**, **COR2**, and **COR3**.

Area:
COR1
S. 10°38'26" E. @ Elev. 500.00 ft
S. 10°38'26" E. 936.0006 ft
N. 10°38'25" W.
Lat: -919.9062 Dep: 172.8289
COR2
N. 83°53'11" W. @ Elev. 500.00 ft
N. 83°53'13" W. 651.0800 ft
S. 83°53'16" E.
Lat: 69.3327 Dep: -647.3779
COR3
N. 29°09'24" E. @ Elev. 500.00 ft
N. 29°09'26" E. 973.9923 ft
S. 29°09'28" W.
Lat: 850.5734 Dep: 474.5376
COR1
Plane area= 291759.6566 sq ft.
Plane area= 6.6979 acres
Scaled area at sea level:
Scaled area= 291671.8775 sq ft.
Scaled area= 6.6959 acres
Scaled area at 500.00 ft.:
Scaled area= 291690.5104 sq ft.
Scaled area= 6.6963 acres

Area:
COR1
S. 10°10'08" E. 935.9821 ft
Lat: -921.2791 Dep: 165.2490
COR2
N. 83°24'54" W. 651.0669 ft
Lat: 74.6627 Dep: -646.7717
COR3
N. 29°37'46" E. 973.9730 ft
Lat: 846.6164 Dep: 481.5227
COR1
Plane area= 291759.6566 sq ft.
Plane area= 6.6979 acres

Geodetic Mode

Plane Mode

Figure 6.15: Area Computation Example

List coords

The 'List coords' function, or the **L** hot key, will list either a single or a group of operator specified stations to the display area. When the number of listed stations exceeds the display area, the operator can scroll through the list with the up arrow, down arrow, pageup (PgUp), and pagedown (PgDn) keys. To access use of these keys, however, the operator must use the <Esc> and <Enter> keys until the pull-down menu bar appears. When this function is invoked, the command line becomes *1ST, LAST OR ? for All*.

Entering the '?' will list every station to the display area currently in the defined coordinate (.cr) file. An operator can list only one station by defining that station at the *1ST, LAST OR ? for All* command line.

Station names are defined alphabetically, not numerically! This means that if station names were defined to be 1 through 99, for example, listing the stations between 1 and 5 would result in a list from 1 to 49, not including the stations 6 through 9. Listing the stations 1 through 10 would result in a list with only the numbers 1 and 10. Below are some examples of group listing functions from the command line and their results to the display area. Also note that the case of the input at the command line does affect this function.

Command Line Input

SET

100

MON,SET

100,200

Display Area Result

List all stations beginning with **SET**.

List all stations beginning with **100**.

List all stations beginning with **MON** to stations beginning with **SET**.

List all stations beginning with **100** to stations beginning with **200**

It is important to remember each character of input is examined in the 'List coords' function. For example, **110** and **101** would be listed in the last example shown above because the second and third characters of these examples, respectively, are greater than the second and third characters of **100**. If in geodetic mode, the coordinates will be listed in Latitude, Longitude, and Elevation. If in plane mode, the coordinates will be listed by Northing, Easting and Elevation. Figure 6.16 shows two examples of the 'List coord' function with **COR** as the input. One example is in geodetic mode, while the other is in plane mode.

Point ID	Elevation	Point ID	Elevation
Latitude	Longitude	Northing	Easting
COR1	500.0000 ft	COR1	500.0000 ft
39°28'27.17430"	77°45'05.79365"	598468.0454 ft	587816.7087 ft
COR2	500.0000 ft	COR2	500.0000 ft
39°28'18.08269"	77°45'03.58982"	597546.7663 ft	587981.9577 ft
COR3	500.0000 ft	COR3	500.0000 ft
39°28'18.76792"	77°45'11.84474"	597621.4290 ft	587335.1860 ft

Geodetic Mode

Plane Mode

Figure 6.16: List Coord Example

Input coords

The 'Input coords' function, or the **I** hot key, allows operators to key in station names with coordinates. Below are the steps required to input a station name and coordinates in CEFB in the Geodetic and Plane modes. This function can be exited any time by pressing the <Esc> or <Enter> keys until the pull-down menu bar appears.

Input Coords in Geodetic Mode

1. Answer the initial *Point ID ?* command line with the desired station ID. Example: **NEW**
2. Answer the *Lat (d.mmss) ?* command line with the appropriate Latitude value. Example: **39°28'30"** or **39.2830**
3. Answer the *Lon (d.mmss) ?* command line with the appropriate Longitude value. Example: **77°45'30"** or **77.4530**
4. Answer the *Elev= ?* command line with the appropriate Elevation value. Example: **460.23**
5. If the operator entered a already existing station ID in step one, he or she will be presented with the prompt in Figure 6.9 (Overwrite original coords ?).

6. The new station ID and its coordinates are presented to the display area. The coordinates of the new station are stored in the coordinate (.cr) file, and the command line returns to the initial **Point ID ?** command line, for input of other station.

Input Coords in Plane Mode

1. Answer the initial **Point ID ?** command line with the desired station ID. Example: **NEW**
2. Answer the **Northing = ?** command line with the appropriate Northing value. Example: **598769.6382**
3. Answer the **Easting = ?** command line with the appropriate Easting value. Example: **585920.9102**
4. Answer the **Elev = ?** command line with the appropriate Elevation value. Example: **460.23**
5. If the operator entered a already existing station ID in step one, he or she will be presented with the prompt in Figure 6.9 (Overwrite original coords ?).
6. The new station ID and its coordinates are presented to the display area. The coordinates of the new station are stored in the coordinate (.cr) file, and the command line returns to the initial **Point ID ?** command line, for input of other station.

Figure 6.17 shows two examples of the 'Input coord' function. One example is in geodetic mode, while the other is in plane mode.

Point ID	Elevation	Point ID	Elevation
Latitude	Longitude	Northing	Easting
NEW	460.2300 ft	NEW	460.2300 ft
39°28'30.00000"	77°45'30.00000"	598769.6382 ft	585920.9102 ft

Geodetic Mode

Plane Mode

Figure 6.17: Input Coord Example

Delete Coords

The 'Delete coords' function, or the **D** hot key, will delete either a single or a group of operator specified stations from the coordinate file. When this function is invoked, the command line becomes **FIRST (,LAST) ?**.

An operator can delete only one station by defining that station at the **FIRST (,LAST) ?** command line. An operator can also delete a group of stations by defining the first and last desired station separated by a comma. Stations are searched in the same fashion as the 'List coords' function.

Station names are defined alphabetically, not numerically! This means that if station names were defined to be 1 through 99, for example, deleting the stations between 1 and 5 would result in deleting the stations from 1 to 49, not including the stations 6 through 9. Deleting the stations 1 through 10 would result in only deleting stations 1 and 10. Below are some examples of group deleting functions from the command line and their results. Also note that the case of the input at the command line does affect this function.

Command Line Input

SET1

100400

MON,SET

100,200

Display Area Result

Delete station **SET1**.

Delete station **100**.

Delete all stations beginning with **MON** to stations beginning with **SET**.

Delete all stations beginning with **100** to stations beginning with **200**

It is important to remember each character of input is examined in the 'Delete coords' functions. For example, **110** and **101** would be deleted in the last example shown above because the second and third characters of these examples, respectively, are greater than the second and third characters of **100**. Once the operator defines the stations in which he or she wishes to delete, he or she will always be presented with the prompt shown in Figure 6.18, to assure that this is actually the case.

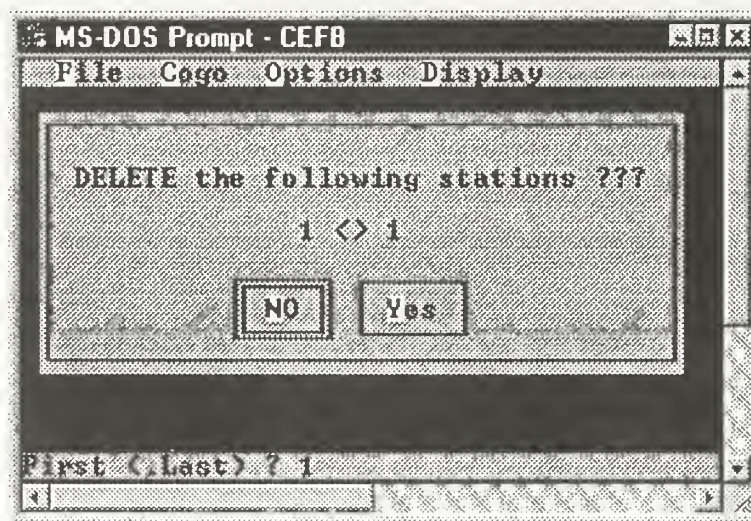


Figure 6.18: Delete Station Prompt

comp int. anGle

The 'comp int. anGle' function, or the **G** hot key, allows surveyors to inverse between a series of stations, in a traversing fashion, while also obtaining the interior angle to right between the stations. Below are the steps required at the command line to performed this function.

1. Answer the initial **BS ?** command line with the desired BS station. Example: **1**
2. Answer the **OC ?** command line with the desired OC station. Example: **2**
3. Answer the **FS ?** command line with the desired FS station. Example: **3**
4. The inverse between the BS and OC stations, the horizontal right angle BS-OC-FS, and the inverse between the OC and FS stations are presented to the display area.
5. Answer the **Next FS ?** command line with the next desired FS station. Example: **4**
6. The previous OC station becomes the BS station, the previous FS station becomes the OC station, and the Next FS station becomes the FS (Like 'Move Up' in the Survey Module).

7. The inverse between the BS and OC stations, the horizontal right angle BS-OC-FS, and the inverse between the OC and FS stations are presented to the displayed area (Same as Step 4).
8. Repeat step 5 as many times as desired to obtain inverses and horizontal right angles between defined stations.

The prompt in Figure 6.7 will be presented to the operator, if any of the stations enter at the command line do not currently exist in the coordinate (.cr) file. This function can also always be exited with the <Esc> or <Enter> keys until the pull-down menu bar appears. Figure 6.19 shows two examples of the 'comp int. anGle' function. Both examples inverse between stations 1-2-3 then 2-3-4. One example is in geodetic mode, while the other is in plane mode.

BS AZ Inverse: 1 S. 89°18'59" W. @ Elev. 152.84 ft S. 89°18'58" W. 434.3893 ft N. 89°18'56" E. Lat: -5.1858 Dep: -434.3583 2 Angle Right 1-2-3: 177°16'44" FS AZ Inverse: 2 S. 86°35'39" W. @ Elev. 127.88 ft S. 86°35'36" W. 868.8578 ft N. 86°35'32" E. Lat: -51.6304 Dep: -867.3224 3 BS AZ Inverse: 2 S. 86°35'39" W. @ Elev. 127.88 ft S. 86°35'36" W. 868.8578 ft N. 86°35'32" E. Lat: -51.6304 Dep: -867.3224 3 Angle Right 2-3-4: 227°46'44" FS AZ Inverse: 3 N. 45°37'43" W. @ Elev. 103.84 ft N. 45°37'46" W. 1047.3623 ft S. 45°37'49" E. Lat: 732.4150 Dep: -748.6896 4	BS AZ Inverse: 1 S. 89°47'07" W. 434.3880 ft Lat: -1.6270 Dep: -434.3850 2 Angle Right 1-2-3: 177°16'43" FS AZ Inverse: 2 S. 87°03'51" W. 868.8564 ft Lat: -44.5010 Dep: -867.7160 3 BS AZ Inverse: 2 S. 87°03'51" W. 868.8564 ft Lat: -44.5010 Dep: -867.7160 3 Angle Right 2-3-4: 227°46'44" FS AZ Inverse: 3 N. 45°09'25" W. 1047.3620 ft Lat: 738.5660 Dep: -742.6220 4
---	---

Geodetic Mode

Plane Mode

Figure 6.19: Comp Int. Angle Example

Options Menu

The two functions within the Options menu are shown in Figure 6.20.

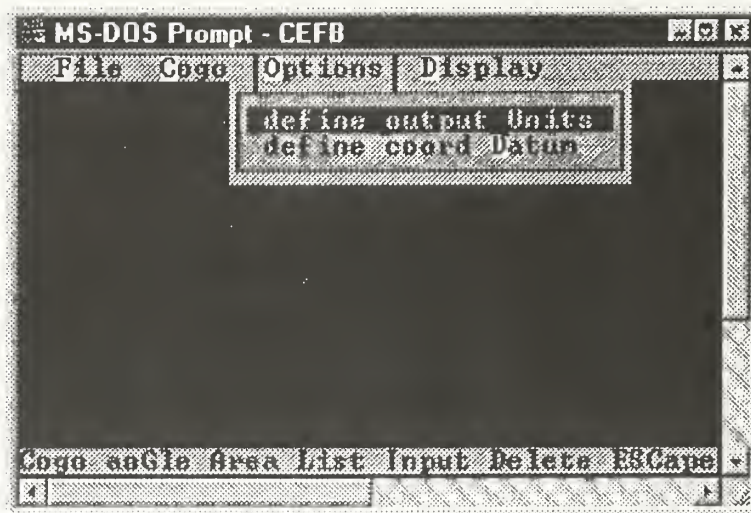


Figure 6.20: Cogo Module Options Menu

define output Units

The 'define output Units' function allows the operator to change the defined linear units in CEFB. When this function is selected, the operator is presented with the prompt shown in Figure 6.21.

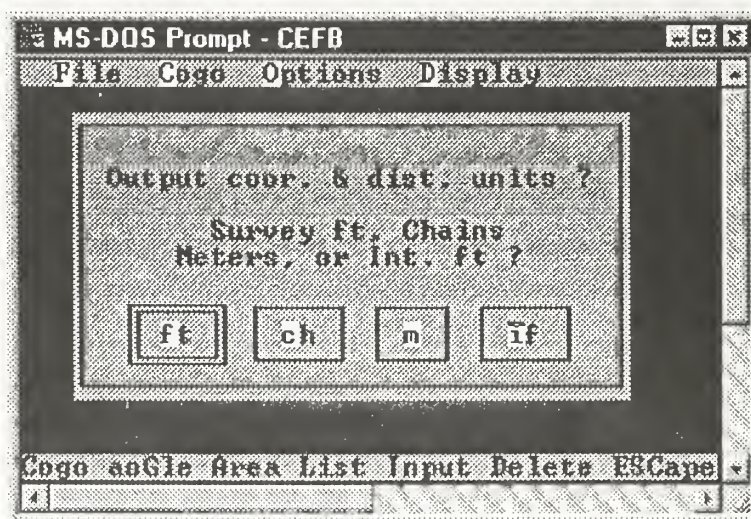


Figure 6.21: Define Output Units Prompt

The output of any subsequent computations will be affected by the units selected horizontally and vertically. Additionally, all subsequent input will be expected to have the same defined units.

define coord Datum

The 'define coord Datum' function allows surveyors to define a geodetic or plane datum environment when collecting observations. This function is described in detail in the Options Menu section of Chapter Three (Main Module).

Display Menu

The Display Menu is shown in Figure 6.22. The only function is this menu has been previously described. The 'change Angular disp.' function is discussed in detail in the Display Menu section of Chapter Three (Main Module).

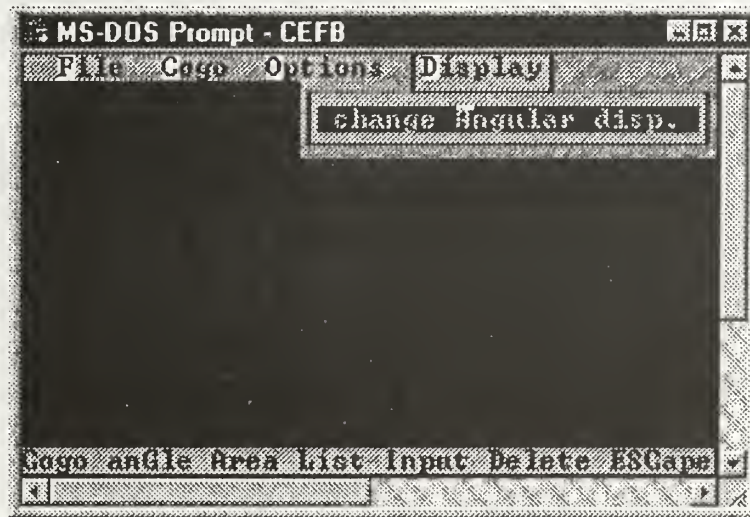


Figure 6.22: Cogo Module Display Menu

CHAPTER SEVEN - CEFB - Trueline Module

Overview

The Trueline Module allows operators to obtain quick information relating their traverse stations to a theoretical 'line' or point. To utilize the Trueline Module, a coordinate (.cr) file with existing coordinates must currently be loaded in CEFB. The main screen of the Trueline Module is shown in Figure 7.1.

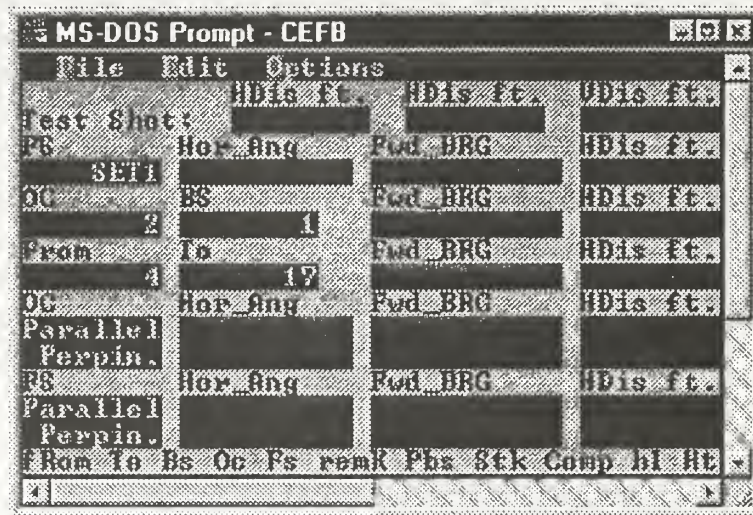


Figure 7.1: Trueline Module

The screen in Figure 7.1 contains many standard features. The top line contains the pull-down menu bar, while the bottom line is the hot key bar. Below the pull-down menu bar, the next two lines on this screen describe offsets for the test-shot function described later in this chapter.

The next two sections of information described the positioning of the three traverse stations (BS, OC, and FS). The first set of information describes the FS station, as well as the bearing/azimuth, and distance from the OC station to the FS station. This line also displays the horizontal right angle to the FS station from the OC and BS stations. The next two lines display the BS, and OC stations as well as the associated bearing/azimuth and distance between these stations. The next section of information on this screen describes the defined 'true line' (FROM and TO stations) along with it's associated bearing/azimuth and distance.

The remaining two sections links the traverse and 'true line' information together. The two sections displays the offset information from 'true line' to the OC and FS stations, respectively. Each section is broken down into three rows and four columns of information.

The first row defines the traverse station and the parallel or perpendicular offsets. The second row relates information from the defined traverse to a line parallel to the defined 'true line', and the third row relates information from the defined traverse to a line perpendicular to the 'true line'.

The first column identifies the traverse station (OC or FS) and the parallel or perpendicular offset to 'true line'. The second column contains the horizontal right angle to the designated object. For the OC offsets, the angle is from the OC and BS stations to the designated object, while for the FS offset the angle is from the FS and OC stations to the designated object. The designated object differs between the parallel and perpendicular offsets. The designated object for the parallel offset is a point on a line parallel to the 'true line' through the defined traverse station and even with the endpoint of the 'true line'. The designated object for the perpendicular offset is a point on the 'true line' perpendicular to the defined traverse station. The third and fourth columns display the bearing/azimuths and distance from the defined traverse station to the specified object. Figure 7.2 illustrates the parallel and perpendicular offsets in detail.

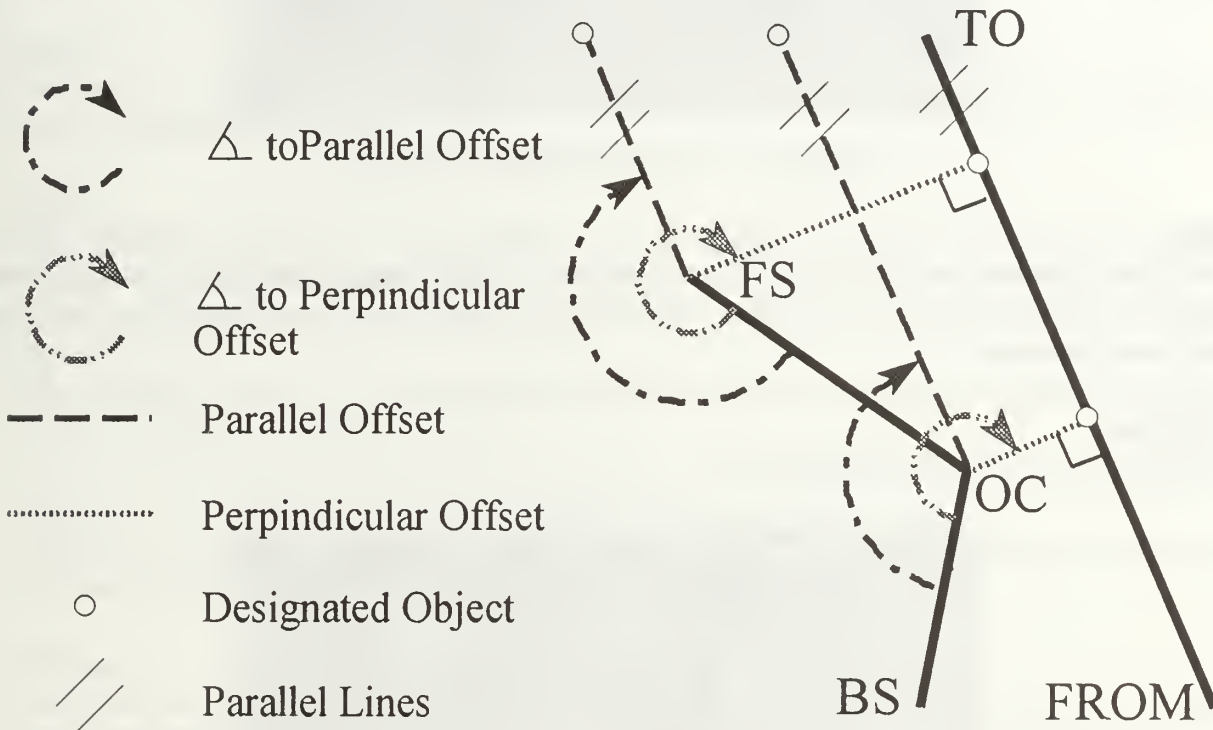


Figure 7.2: Parallel and Perpendicular Offsets to 'True Line'

File Menu

The file menu is shown in Figure 7.3. Two of these functions have been detailed in earlier sections. The **Shell** and **Version** functions are discussed in the File Menu section of Chapter Three (Main Module).

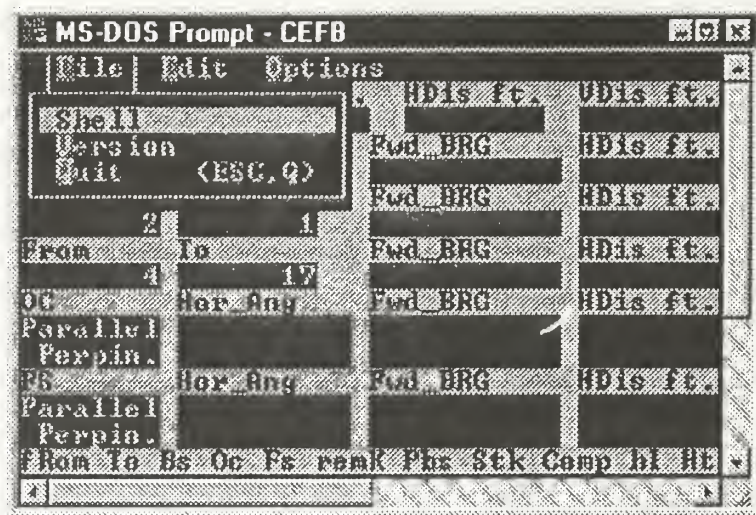


Figure 7.3: Trueline Module File Menu

Quit

The 'Quit' function, or the **Q** or **ESC** hot keys, returns the operator back to the module from which the Trueline Module was evoked. The Trueline Module may be activated from the Main and Survey Modules.

Edit Menu

The Edit Menu is shown in Figure 7.4.

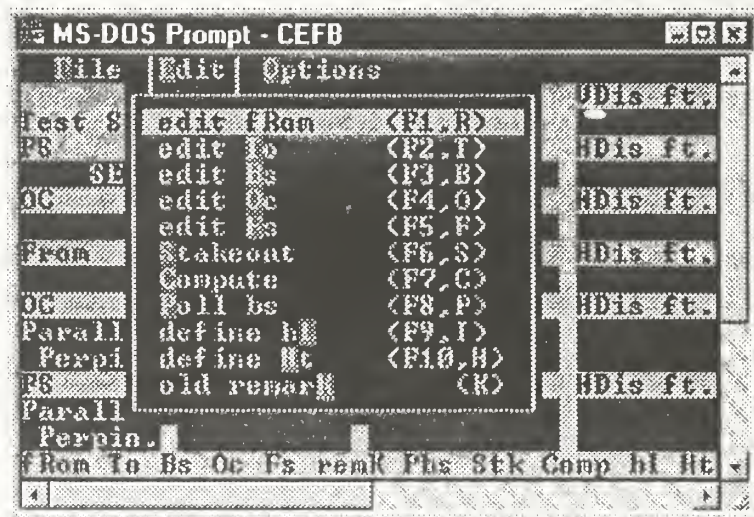


Figure 7.4: Trueline Module Edit Menu

These functions are used to specify the foresight, back sight, and occupied stations, as well as the stations defining the trueline. There are also computational and test-shot functions pertaining to a defined stakeout.

Edit Functions

The following edit functions may be performed at any time in the initial screen of the Trueline Module. These functions allow the user to alter or change all of the station fields shown in the initial screen of the Trueline Module in Figure 7.1. The edit windows for these functions are eight characters long and have the same appearance and functionality as the BS station window prompt shown in Figure 4.29.

edit fRom

The 'edit fRom' function, or the **F1** or **R** hot keys, allows the operator to alter or change the currently displayed From station.

edit To

The 'edit To' function, or the **F2** or **R** hot keys, allows the operator to alter or change the currently displayed To station.

edit Bs

The 'edit Bs' function, or the **F3** or **B** hot keys, allows the operator to alter or change the currently displayed Back sight station.

edit Oc

The 'edit Oc' function, or the **F4** or **O** hot keys, allows the operator to alter or change the currently displayed Occupied station.

edit Fs

The 'edit Fs' function, or the **F5** or **F** hot keys, allows the operator to alter or change the currently displayed Foresight station.

Stakeout

The 'Stakeout' function, or the **F6** or **S** hot keys, allows surveyors to search for the two closest station ID's for the BS and OC stations based on a defined FS (point to be staked) station. The 'Stakeout' function prompts the surveyor to define the station to be staked out. This prompt is shown in Figure 7.5.

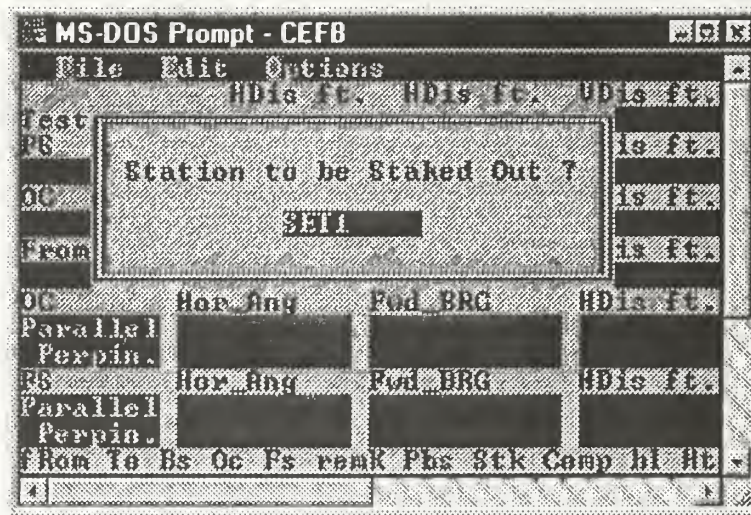


Figure 7.5: Station to be Stakeout Prompt

This function enables surveyors to define specific strings and/or a search radius in the search for the OC and BS stations. This can be helpful, for example, when searching for the closest traverse stations to a monument which needs to be staked out. The prompt to proceed with the define search is shown in Figure 7.6. If a defined search is not selected, the 'Stakeout' function will return the closest station to the OC field and the second closest station to the BS field.

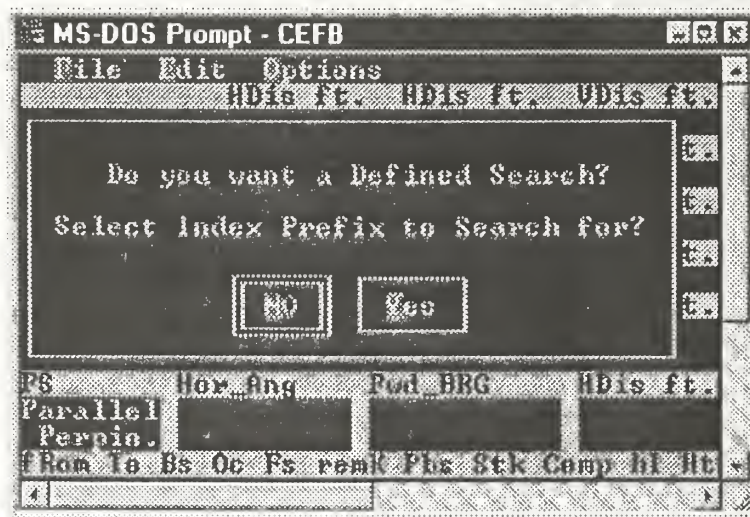


Figure 7.6: Defined Search Prompt

The search for stations can be defined one of two ways. The first way is to select one of the prefixes from the index file. This will result in only stations matching the selected prefix in the BS and OC fields. Once the surveyor proceeds with a defined search, a pick list, as shown Figure 7.7, of available features and their corresponding prefixes is displayed.



Figure 7.7: Index Pick List

This can be extremely helpful when a surveyor is extensively using automatic point indexing, and he or she want to return only a particular feature to the BS and OC field. For example, a surveyor wants to stakeout station 'SET1', and he or she only wants to return traverse stations to the BS and OC fields. Selecting the **TRAVERSE-STA** feature from the pick list shown in Figure 7.7 will perform that function. See Chapter Nine for automatic point indexing.

The second search method is to define a specific search string. This is accessed with the **ESC** key in the pick list in Figure 7.7. This allows the surveyor to manually define the string to be searched for in each station. This prompt is shown in Figure 7.8.

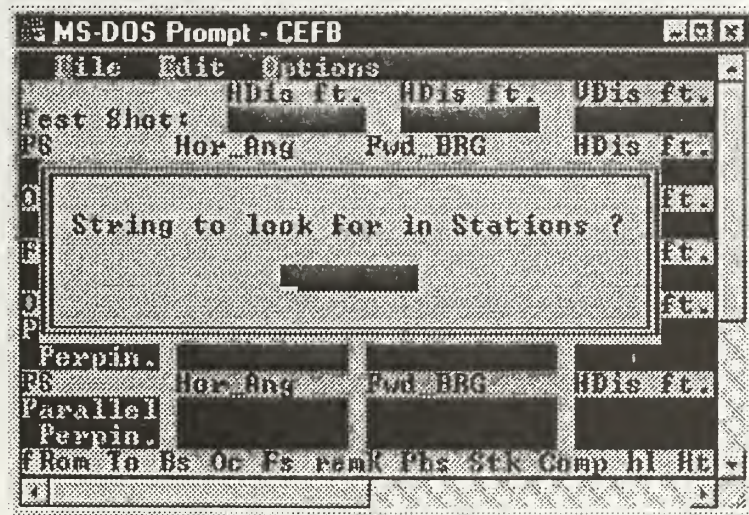


Figure 7.8: String to be Search for Prompt

The next step in a defined search in the 'Stakeout' function enables surveyors to fix the limits of the search area from the stakeout station ID. The prompt requesting this procedure is shown in Figure 7.9.

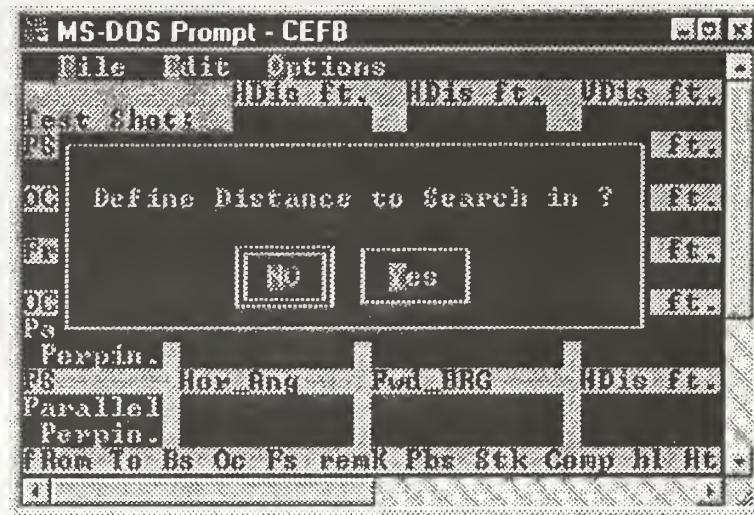


Figure 7.9: Define Search Distance Prompt

If the surveyor accepts the defined searched distance prompt, he or she is then asked to define the search distance as shown in Figure 7.10.

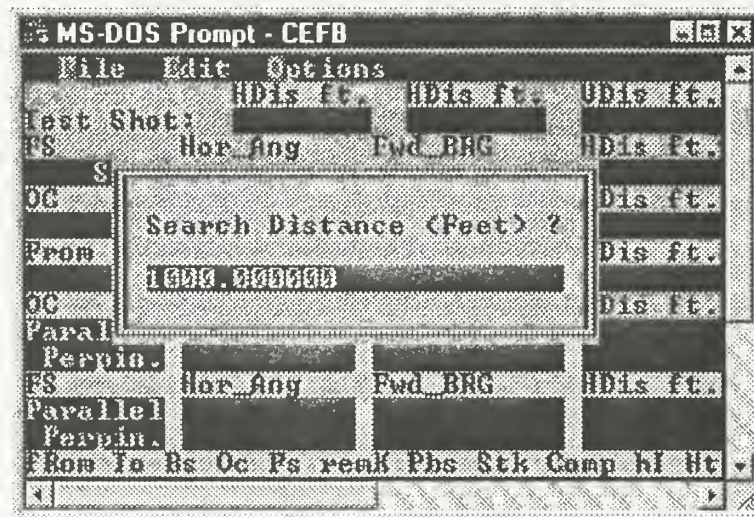


Figure 7.10: Search Distance Prompt

The distance in the prompt in Figure 7.10 will always match the defined output units. The default distance for the prompt in Figure 7.10 is 1000.00. The two closest stations that meet the requirements specified by the defined search will be returned in the BS and OC stations fields. If only one station ID meets the defined requirements, it is returned in the OC station field and the BS station field remains empty.

Figure 7.11 shows the results the 'Stakeout' function, defining 'SET1' as the staked out station, TRAVERSE-STA feature, and a 500.00 foot search distance.

File	Edit	Options
Test Shot:	HDIs ft.	UDIs ft.
PS	Hor Ang	Pod BRG
OC	BS	Pod BRG
From	To	Pod BRG
Parallel	Hor Ang	Pod BRG
Perpin.		
PS	Hor Ang	Pod BRG
Parallel		
Perpin.		
From	To	BS
PS	OC	PS
ESC	Phs	Stk
Comp	hl	Ht

Figure 7.11: 'Stakeout' Function Results

Compute

The 'Compute' function, or the F7 or C hot keys, allows surveyors to define any and all fields before any computations occur. Once the desired fields have been defined, 'Compute' will process the calculations and produce the screen shown in Figure 7.12.

File	Edit	Options
Test Shot:	HDIs ft.	UDIs ft.
PS	Hor Ang	Pod BRG
OC	BS	Pod BRG
From	To	Pod BRG
Parallel	Hor Ang	Pod BRG
Perpin.		
PS	Hor Ang	Pod BRG
Parallel		
Perpin.		
From	To	BS
PS	OC	PS
ESC	Phs	Stk
Comp	hl	Ht

Figure 7.12: Computation Screen

The <Enter> key will return operators to the initial screen of the Trueline Module and blank the computational fields. Station fields may not be edited until <Enter> is pressed. Note: Functions in the computation screen may only be invoked from the hot key bar.

Poll bs

The 'Poll bs' function, or the **F8** or **P** hot keys, creates a setup in the Trueline Module, and allows the surveyor to poll the BS of that setup. This function leads into the 'Obs-tshot' function within the hot key bar on the computation screen in Figure 7.12. The 'Obs-tshot' function will be described later in this section. The 'Poll bs' function can also be invoked in the computation screen in Figure 7.12. For the 'Poll bs' to correctly create a setup in the Trueline Module, the BS, OC, and FS must all currently exist in the coordinate (.cr) file. If this is not the case the operator will be presented with the prompt shown in Figure 7.13, and returned to the main screen of the Trueline Module without creating a setup.

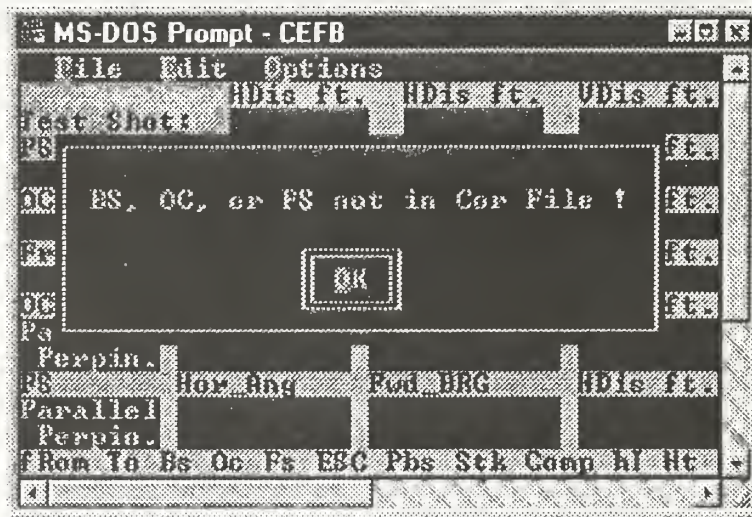


Figure 7.13: BS, OC, or FS not in Cor File

Once the BS, OC, and FS stations in the Trueline Module are defined and are in the coordinate (.cr) file, the operator is presented with the prompt in Figure 7.14.

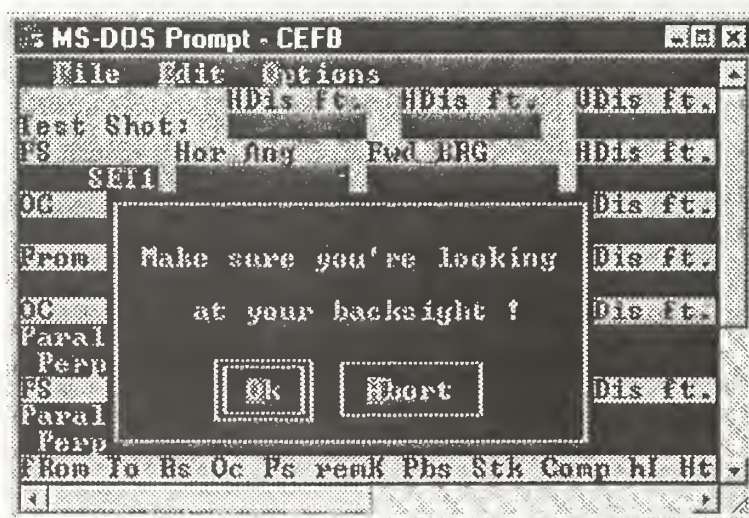


Figure 7.14: Make sure you're looking at the BS

MS-DOS Prompt - CEFB

File		Edit		Options	
		HDIs ft.	Fwd BRG	ODIs ft.	
Test Shot:					
PS	5.00	Hor Ang	Fwd BRG	HDIs ft.	
SEII					
OC	5.00	BS	Fwd BRG	HDIs ft.	
	16	15			
From	To		Fwd BRG	HDIs ft.	
	4	17			
OC		Hor Ang	Fwd BRG	HDIs ft.	
Parallel					
Pervin.					
PS		Hor Ang	Fwd BRG	HDIs ft.	
Parallel					
Pervin.					
From	To	Bs	Oc	Ps	Peak
		Pbs	Stk	Camp	HI
		HG			

The 'defi

MS-DOS Prompt - CEFB

File Edit Options

Test Shot:

FS 5.00 Hor Ang Pwv BRG HDls ft.

SEff

OC 5.00 H HDls ft.

16 HI ? <5.000> ?

From T HDls ft.

4 HDls ft.

OC H HDls ft.

Parallel

Perpin.

FS Hor Ang Pwv BRG HDls ft.

Parallel

Perpin.

From To Bs Oc Ps remK Pbs Stk Comp HI Ht

define Ht

The 'define Ht' function, or the **F10** or **H** hot key, allows the surveyor to redefine the height of target (HT) for the FS station once a setup is created in the Trueline Module with the 'Poll bs' function. The current height of target is **5.00** shown next to 'FS' field in the fourth line of Figure 7.15. Figure 7.17 displays the 'define Ht' prompt.

MS-DOS Prompt - CEFB

File Edit Options

Test Shot: HDIs ft. HDIs ft. UDIs ft.

PS 5.00 Hor_Ang Fwd_BRG HDIs ft.

SE11

OC 5.00 B HDIs ft.

15 HT ? <5.000> ?

From I HDIs ft.

4 HDIs ft.

OC

Parallel

Perpin.

PS Hor_Ang Fwd_BRG HDIs ft.

Parallel

Perpin.

From To Bs Oc Ps remk Pbs Stk Comp HI HT

Figure 7.17: 'define Ht' Prompt

Figure 7.18 displays the main screen of the Trueline Module after defining the HI and HT to be **5.55** and **5.25** respectively. It is also important to remember that both the 'define hI' and 'define Ht' functions can be invoked from the hot key bar of the computation screen shown in Figure 7.12.

MS-DOS Prompt - CEFB

File Edit Options

Test Shot: HDIs ft. HDIs ft. UDIs ft.

PS 5.25 Hor_Ang Fwd_BRG HDIs ft.

SE11

OC 5.55 BS Fwd_BRG HDIs ft.

16 15

From To Fwd_BRG HDIs ft.

4 12

OC Hor_Ang Fwd_BRG HDIs ft.

Parallel

Perpin.

PS Hor_Ang Fwd_BRG HDIs ft.

Parallel

Perpin.

From To Bs Oc Ps remk Pbs Stk Comp HI HT

Figure 7.18: Trueline Module after 'define hI' and 'define Ht' Functions

Obs-tshot

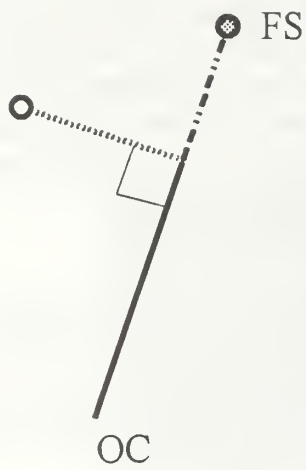
The 'Obs-tshot' function can only be invoked from the computation screen of the Trueline Module with the **O** hot key from the hot key bar. The 'Obs-tshot' function allows surveyors to observe a rod location, and acquire offsets from the rod location to the line between the OC and FS stations in the Trueline Module. This can be a very useful function when staking out a corner move. The 'Obs-tshot' function returns three offsets values to the third line of the computation screen.

Right or Left Offset

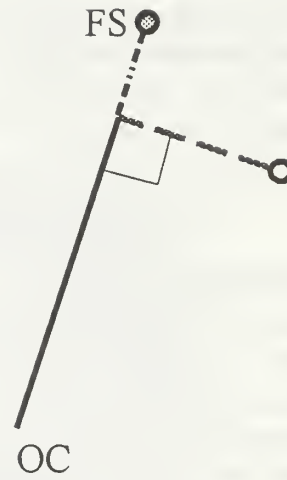
The first value gives the perpendicular distance from the rod location to the line between the OC and FS stations. The **R** for right or **L** for left offset give the direction in which the rod needs to move in order to place the rod on the line between the OC and FS stations from the instrument person's perspective. The **R** or **L** character is positioned directly on front of the right or left offset distance on the third line of the Trueline Module.

'-' or '+' Offset

The second value gives the distance from the computed perpendicular position from the Right or Left offset to the FS station. The '-' for right or '+' for offset gives the direction in which the rod needs to move in order to place the rod at the FS station location from the instrument person's perspective. The '-' offset indicates the rod needs to move towards the instrument, while the '+' offset indicates the rod needs to move away from the instrument. The '-' or '+' character is positioned directly on front of the '-' or '+' offset distance on the third line of the Trueline Module. Figure 7.19 illustrates the four possible offset scenarios for the 'Right or Left' and '-' or '+' offsets.



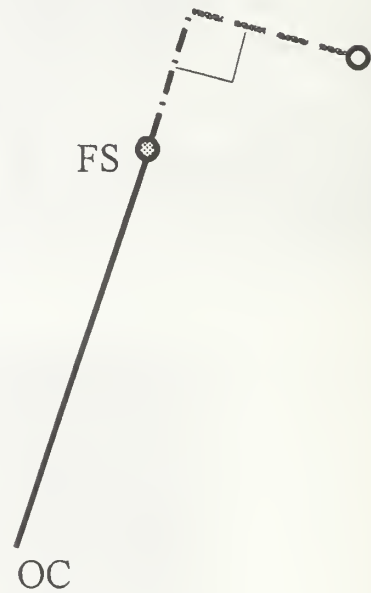
Right '+' Offset



Left '+' Offset



Right '-' Offset



Left '-' Offset

- Rod Location Right Offset Value - · - · - · '-' Offset Value
 ⊗ FS Location Left Offset Value - - - - - '+' Offset Value

Figure 7.19: 'Right or Left' and '-' or '+' Offset Scenarios

Up or Down Offset

The third value gives the distance in which the rod needs to move to match the elevation of the FS station. This is where the 'define hI' and 'define Ht' functions come into play. The (HI) and (HT) values must be accurate to receive a correct value for this offset. The **Up** offset indicates the rod needs to move up to match the FS elevation, while the **Down** indicates the rod needs to move down to match the FS elevation. The U or D character is positioned directly on front of the Up or Down offset distance on the third line of the Trueline Module.

Obs-tshot Example

The horizontal right angle and distance from the OC station (16) to the FS station (SET1) is $292^{\circ}34'35''$ 92.929 ft. from the computation screen shown in Figure 7.12. Based on that information, the rod person paces out to that general location. The instrument uses the 'Poll bs' function to create a setup, observe the BS station, and set the horizontal angle to zero. The instrument then dials $292^{\circ}34'35''$ into the instrument and puts the rod person generally on line. Then, from the computation screen, the instrument person uses the **O** hot key, from the hot key bar, to observe the rod location. Once the observation is complete, the offset values and directions will be returned to the third line of the computation screen. For this example, let's say the elevation of station 16 is 128.908 ft., the elevation of station SET1 is 130.12 ft., the (HI) is 5.55 ft., the (HT) is 5.25 ft., and the observations to the rod are $292^{\circ}50'30''$, $89^{\circ}30'30''$, and 86.50 for the horizontal right angle, vertical angle, and slope distance respectively. Figure 7.20 displays the result of this scenario.

File	Edit	Options
Save obs	HDIs ft.	VDIs ft.
Test Shot: L	0.401	6.433 0
BS 5.25	Hor Ang	Pod BRG
SET1	$292^{\circ}34'35''$	$N17^{\circ}26'5''E$
OC 5.45	BS	Pod BRG
16	15	$N84^{\circ}51'31''E$
From	To	Pod BRG
4	17	$N91^{\circ}55'5''W$
OC	Hor Ang	Pod BRG
Parallel	$243^{\circ}13'24''$	$N31^{\circ}55'5''W$
Perpin.	$333^{\circ}13'24''$	$N58^{\circ}4'55''E$
BS	Hor Ang	Pod BRG
Parallel	$130^{\circ}30'50''$	$N31^{\circ}55'5''W$
Perpin.	$220^{\circ}30'50''$	$N58^{\circ}4'55''E$
Enter to cont. Pbs Obs-tshot reack HI Ht		

Figure 7.20: Obs-tshot Results

Based on the assumptions noted above, Figure 7.20 indicates to the surveyor that the rod person needs to move to the left **0.401 ft.** and back up **6.433 ft.** to arrive at the FS station location. Figure 7.19 also indicates that the rod needs to move up **0.170 ft.** to match the FS elevation. The instrument person relays that information to the rod person, and the rod person makes his or her adjustments. The instrument person puts the rod person on line with a little more detail and uses the **O** hot key to update the offset values and see how close the rod person is. The **O** hot key for the 'Obs-tshot' function can be utilized as many times as necessary to position the rod person at the FS location.

Once the FS station location is determined with the 'Obs-tshot' function, the surveyor can save the last observation to the rod to the field (.ff) file if desired. This can be very help, for instance, when a surveyor is setting a monument. The surveyor uses the 'Obs-tshot' function to determine the FS station location. The monument is set, then the instrument person locates the rod on the monument to see the proximity of the monument to the computed position. This last observation to the rod is saved to the field (.ff) file.

Observations are saved to the field (.ff) file with the 'Obs-tshot' function in the computation screen with the **S** hot key. The operator is notified of the save option after a test shot has been taken with the **S-save obs** text above the Test Shot: text on the second line of the computation screen.

Surveyors would not want to save a observation to the field (.ff) file with the **S** for **S-save obs** option which is not close to the desired FS station (large offsets). Because of this, observations with offsets larger than 0.20 of the defined output unit, that are attempted to be save the field (.ff) file will produce the prompt shown in Figure 7.21.



Figure 7.21: S-save obs Trap for Large Offsets

old remark

The 'old remark' function, or the K hot key, displays a pick list of available feature codes in the feature code file. This function is described in detailed in the setup menu section of Chapter Four (Survey Module).

Options Menu

The Options Menu is shown in Figure 7.22. All of these functions have been described in detail in earlier sections. The **define output Units** function is described in the option menu section of Chapter Six (Cogo Module), while the **change Angular disp.** and **Fwd/Mean disp.** functions are described in the Display Menu section of Chapter Three (Main Module).

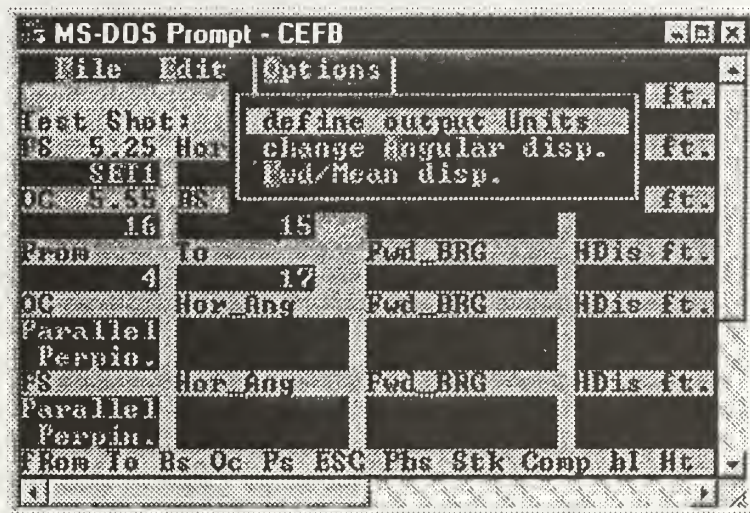


Figure 7.22: Trueline Module Options Menu

CHAPTER EIGHT - CEFB - Read/Edit Module

Overview

The Read/Edit Module is where observations and field descriptions in the field file may be reviewed and/or edited. The main screen of the read/edit is shown in Figure 8.1

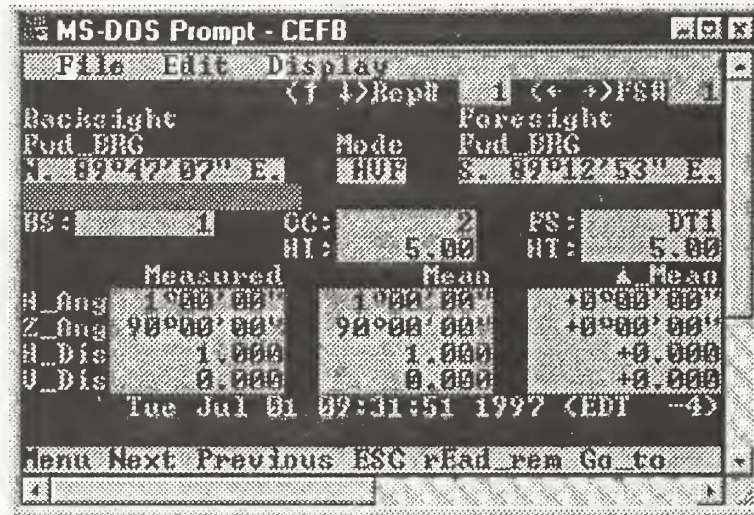


Figure 8.1: Read/Edit Module

The look of the Read/Edit Module is very similar to the Survey Module. However, the pull-down menu and hot key bar contain slightly different functions. There is also an additional area below the defined BS station name which indicates the status of the observation. Observations may appear as unedited, 'DELETED', 'UN_DELETED', or 'MODIFIED'. The status of edited observations are indicated in the observation (.obs) file with the D, U, and M characters directly following the setup 'S' and foresight 'F' records.

As described in earlier sections for the Survey and Astro Modules, the arrow keys are used to scroll through observations. The up and down arrow keys are used for scrolling through repetitions, while the right and left arrow keys are used to scroll through foresight stations.

'N' for Next and 'P' for Previous

Unlike the data collection modules, the operator may scroll the various setups of the defined field file. The letter 'N' (next) scrolls forward through the setups, and the letter 'P' (previous) scrolls backwards through the setups. These functions can only be accessed through the hot key bar.

File Menu

The File Menu is shown in Figure 8.2. All of these functions have been described in earlier sections and are common functions in CEFB. The **open Field file**, **Open coord file**, **Shell**, and **Version** functions are described in the File Menu section of Chapter Three (Main Module). The **Trueline** and **Cogo** functions are described in the Function Menu section of the Chapter Three (Main Module). The **Quit** function, or the Q or ESC hot keys, quits the Read/Edit Module and returns the operator to the Main Module.

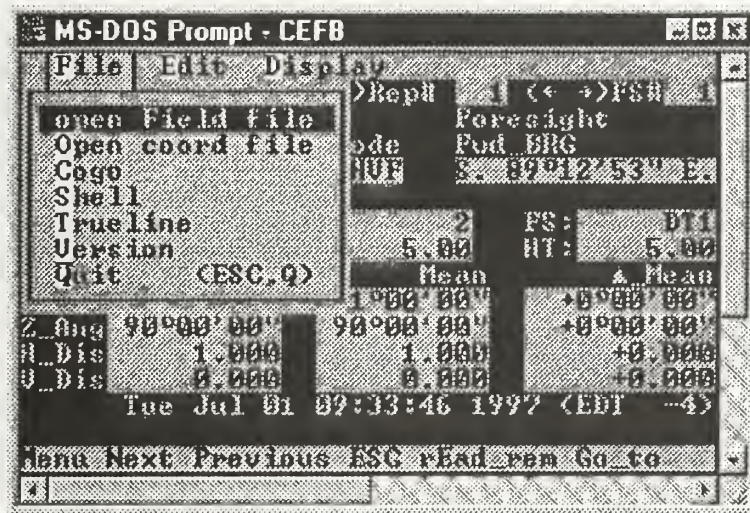


Figure 8.2: Read/Edit Module File Menu

Edit Menu

The Edit Menu is shown in Figure 8.3. The functions in this menu are used to edit or modify observations and descriptions in the field file. Observations deleted, modified, or un-deleted using the following functions are not removed from the field file, but are flagged as either deleted, modified, or un-deleted with characters ('D', 'M', or 'U') identifiers called flags. The flags identify which observations should be recognized or ignored by CEFB and the post-processing program TOLSA.EXE.

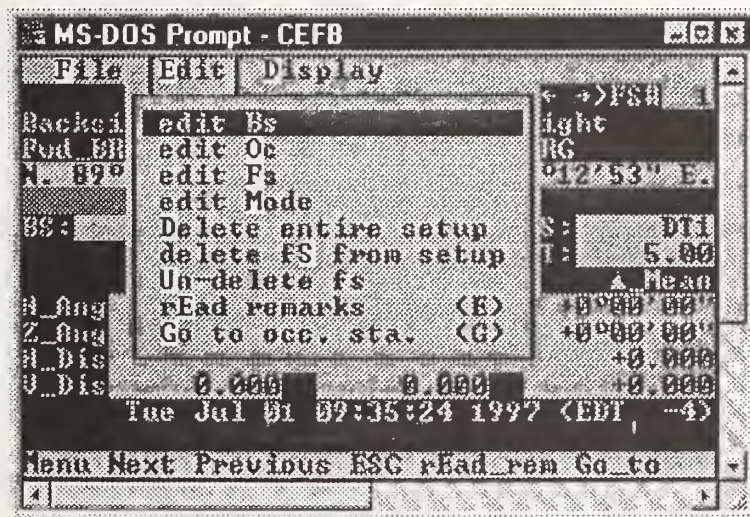


Figure 8.3: Read/Edit Module Edit Menu

edit Bs

The 'edit Bs' function allows the operator to re-name the BS station with a standard station name window. The setup will be tagged as **MODIFIED** in the Read/Edit Module, however, both the original and **MODIFIED** versions of the setup 'S' record will be in the observation (.obs) file. Editing the BS station will also affect all observations within the current setup. For instance, changing the BS station name will result in the horizontal circle readings of the foresights for the setup to be computed from the new defined BS station name. This will also effect the coordinates of the observations for the setup. Below is a example of the original and modified versions of a setup 'S' record with the edited BS station.

	10	20	30	40	50	60	70	80	90
123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	12..
S	STA1	STA2	5.500						Fri May 11 07:41:53 1997
SM	TRAV1	STA2	5.500						Fri May 11 07:41:53 1997

edit Oc

The 'edit Oc' function allows the operator to re-name the OC station with a standard station name window. The setup will be tagged as **MODIFIED** in the Read/Edit Module, however, both the original and **MODIFIED** versions of the setup 'S' record will be in the observation (.obs) file. Editing the OC station will also affect all observations within the current setup. For instance, changing the OC station name will result in the horizontal circle readings of the foresights for the setup to be computed from the new defined OC station name. This will also effect the coordinates of the observations for the setup. Below is a example of the original and modified versions of a setup 'S' record with the edited OC station.

	10	20	30	40	50	60	70	80	90
123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	12..
S	STA1	STA2	5.500						Fri May 11 07:41:53 1997
SM	STA1	TRAV2	5.500						Fri May 11 07:41:53 1997

edit Fs

The 'edit Fs' function allows the operator to re-name FS station and HT (if the HI/HT prompt is activated). This particular FS station will be tagged as **MODIFIED** in the Read/Edit Module, however, both the original and **MODIFIED** versions of the foresight 'F' record will be in the observation (.obs) file. Below is a example of the original and modified versions of a setup 'F' record with the edited FS station.

	10	20	30	40	50	60	70	80	90
123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	12..
F	SS01	2	5.000	21 15 25.0	272 08 10.0	145.630	0.000		Fri May 11 07:43:57 1997
FM	SS02	2	5.000	143 59 47.0	267 59 55.0	225.050	0.000		Fri May 11 07:44:57 1997

edit Mode

The 'edit Mode' function allows the operator to re-define the instrument measurement mode for a FS observation. Figure 4.32 displays the prompt for this function., the operator is prompted to choose from three possible modes. Below is a example of the original and modified versions of a setup 'F' record with the mode changed from HVF to HV.

	10	20	30	40	50	60	70	80	90
123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	12..
F SS01	2	5.000	21 15	25.0 272 08	10.0	145.630	0.000	Fri May 11	07:43:57 1997
FM SS01	0	5.000	143 59	47.0 267 59	55.0	225.050	0.000	Fri May 11	07:44:57 1997

Delete entire setup

The 'Delete entire setup' function allows the operator to delete all observations from every repetition related to the current setup. All observations in every repetition of the current setup are marked as deleted. The warning for this function is shown in Figure 8.4.

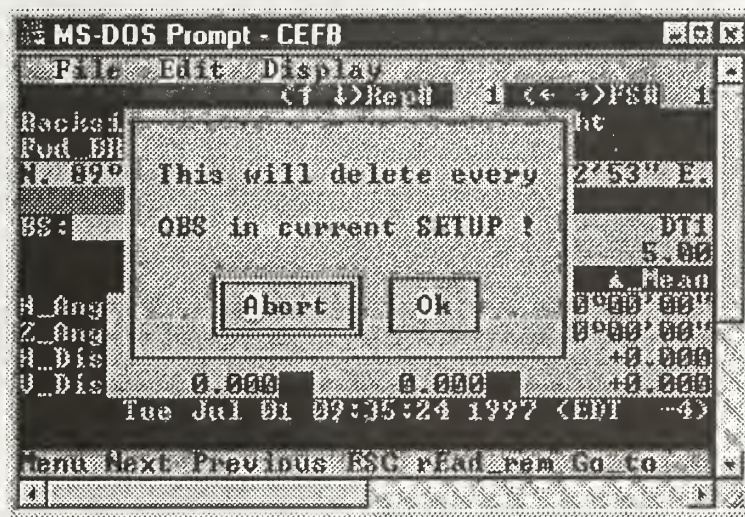


Figure 8.4: Delete Entire Setup Prompt

delete Fs from setup

The 'delete Fs from setup' function allows the operator to delete (attach a 'D' delete flag) the currently displayed FS observation from a setup. The prompt for this function is shown in Figure 8.5.

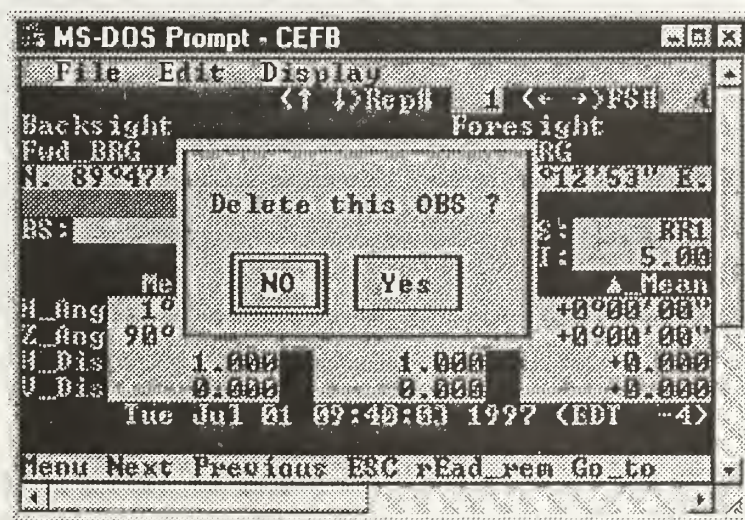


Figure 8.5: Delete Observation Prompt

Un-delete fs

The 'Un-delete fs' function allows the operator to un-delete a previously deleted FS station observation by replacing the 'D' deleted flag with an 'U' un-deleted flag. The prompt for this function is shown in Figure 8.6.

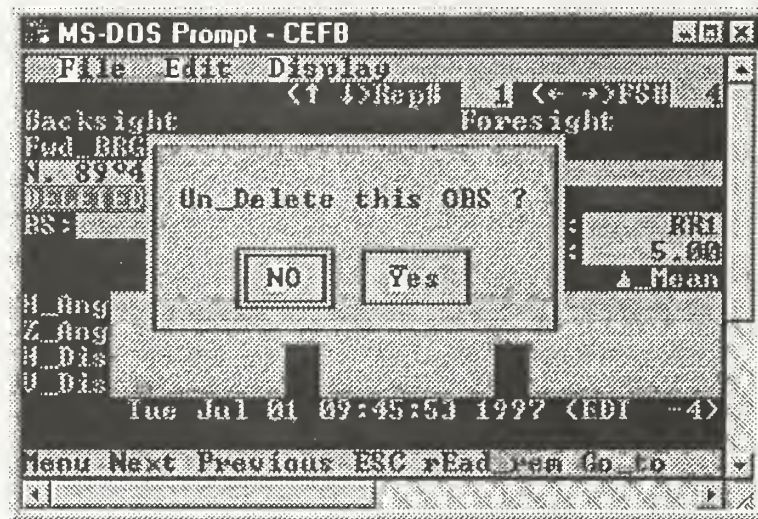


Figure 8.6: Un-Delete Observation Prompt

If the operator attempts to un-delete a FS observation which is not deleted, the prompt in Figure 8.7 will notify the operator that the observation can not be un-deleted.

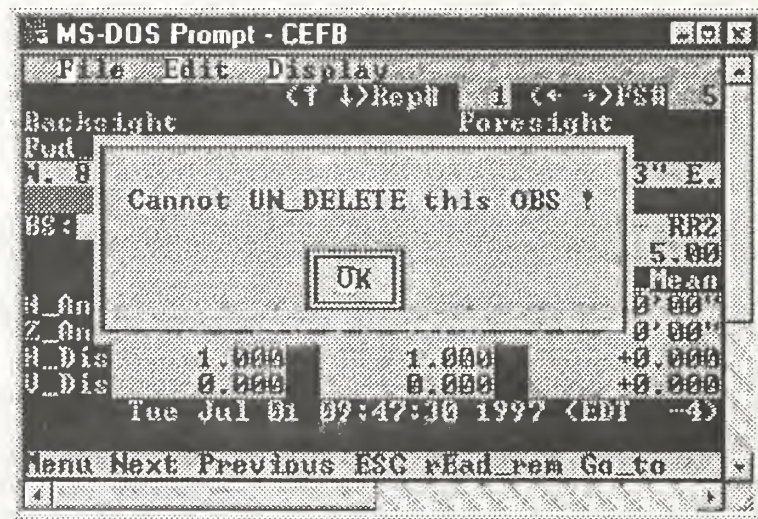


Figure 8.7: Cannot Un-Delete Observation Notice

rEad remarks

The 'rEad remarks' function, or the E hot key, facilitates the viewing and editing of descriptive remarks collected in CEFB. This function is a crucial segment of field note production discussed in detail in Chapter's Twelve and Fourteen. The 'rEad remarks' produces a pick list of available stations with descriptions. This pick list is shown in Figure 8.8.

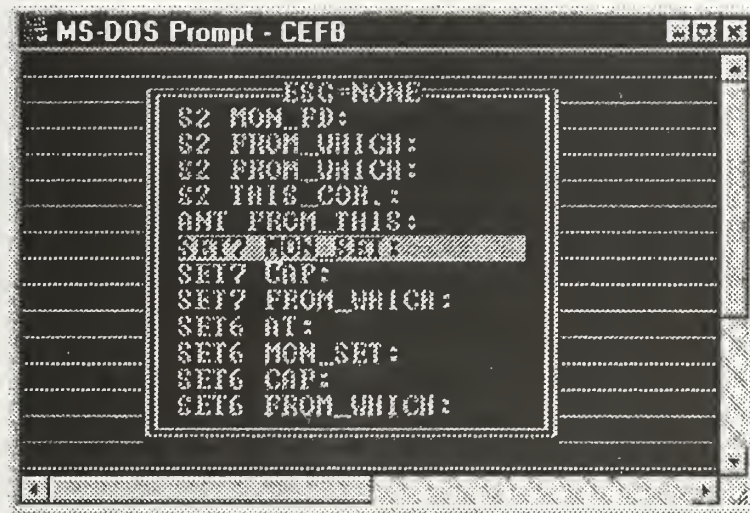


Figure 8.8: Read Remarks Pick List

The pick list in Figure 8.8 displays the station name the description is attached to, and the identifier of the description. If the description is a free form remark (no identifier), the first 20 characters of the remark will be displayed to the pick list. When a station is selected its associated description is displayed at the top of the screen as shown in Figure 8.9.

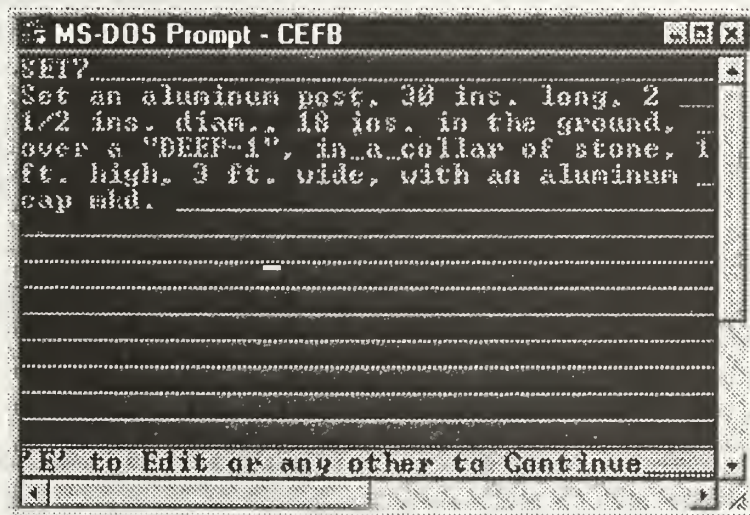


Figure 8.9: Read Remark Screen

As the hot key bar states on the last line of Figure 8.9, the 'E' character key will allow the operator to edit the description with the edit window shown in Figure 8.10, or any other key will return the operator to the main screen of the Read/Edit Module.

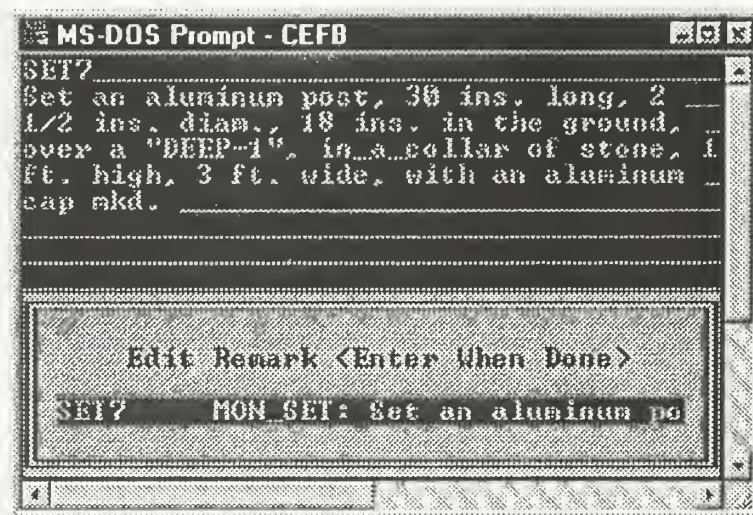


Figure 8.10: Edit Remark Window

The surveyor can view the original remark and the edited remark at the same time. The edit window at the bottom of Figure 8.10 has several editing keys that facilitate elementary editing. The **right** and **left** arrow keys allow the operator to scroll up and down the chain string to get to the desired location. The **HOME** and **END** keys places the cursor at the beginning and end of the description, and the **BACKSPACE** and **DELETE** keys also work accordingly. The original remark is flagged as modified (RM instead of R) with the edited version directly below it in the field (.ff) and observation (.obs) files as shown below.

RM SET7 MON_SET: Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 18 ins. in the ground, over a "DEEP-1", in_a_collar of stone, 1 ft. high, 3 ft. wide, with an aluminum cap mkd.

R SET7 MON_SET: Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 22 ins. in the ground, over a "DEEP-1", with an aluminum cap mkd.

Go to occ. sta.

The 'Go to occ. sta.' function, or the **G** hot key, allows the surveyor to directly select the setup he or she desires to manipulate. This function is achieved through a pick list shown in Figure 8.11.

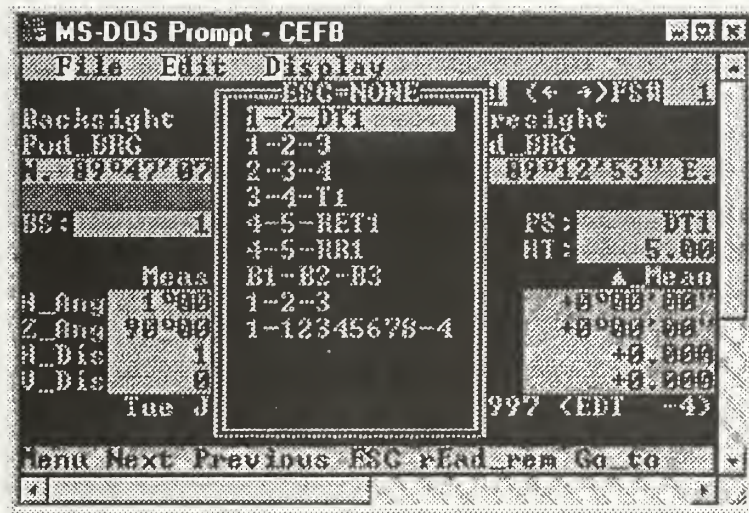


Figure 8.11: Go_To OC Station Pick List

Each selection in the pick list in Figure 8.11 displays the BS, OC, and first FS stations for each setup in the field (.ff) file. Once a selection is made, control is brought to that setup in the Read/Edit Module. The file position stays at the selected setup. This can be very useful for obtaining the desired setup quickly instead of using the Next or Previous functions to scroll through a large number of setups.

Display Menu

The Display Menu is shown in Figure 8.12. The two functions in this menu have been described in detail in earlier sections. The **change Angular disp.** and **Fwd/mean disp.** functions are described in the Display Menu section of Chapter Three (Main Module).

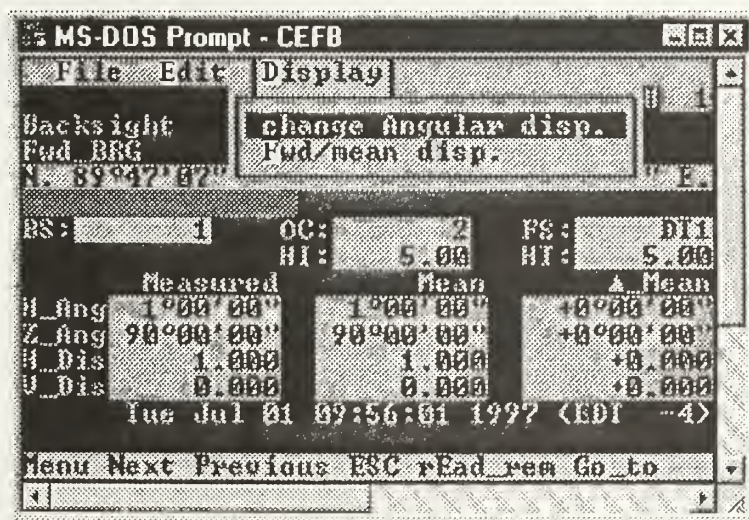


Figure 8.12: Read/Edit Module Display Menu

Updating Coordinates in the Read/Edit Module

When a operator utilizes the 'edit Bs' and 'edit Oc' functions to edit the BS and OC stations of a setup, this can clearly effect the coordinates for that setup as well as consectutive setups. An example of this can be the wrong BS station in a series of traverse setups. To correctly update the coordinates of subsequent setups once the user has edited the BS or OC stations with the 'edit Bs' or 'edit Oc' function, he or she must use the 'Next' function from the hot key bar. As the operator scrolls through each subsequent setup, the coordinates for the observations for each setup will be correctly updated.

CHAPTER NINE - CEFB - Automatic Point Indexing

Overview

The primary reason for blunders in surveying is station identification (ID or naming). The feature code (.fc) file categorizes descriptive features utilized by the surveyor during field data collection. Automatic point indexing extends that same philosophy into the back sight (BS), occupied (OC), and foresight (FS) station ID's, and the collection of numerical and descriptive data for those stations. The feature code can now drive the station ID's. For example, every time a surveyor locates a fence, after the FENCE feature is chosen the corresponding station ID is produced and automatically indexed. This concept is also incorporated into the descriptions of stations ID's. If the surveyor knows the feature defined for a station ID, there is no need to scroll through a pick list of feature codes. For example, if the surveyor desires to describe a FENCE station ID, he or she should have the ability automatically execute the corresponding FENCE feature code without the use of a pick list.

These concepts are implemented with the use of an **Index File**. The index file, (.ind) extension, is created with any text editor in the same fashion as the (.fc) **Feature Code File**. Features defined in the index and feature code files will drive everything you now do in CEFB.

The Index File

A correctly formatted index (.ind) file has three fields: the **prefix**, the **identifier** (feature code), and the **suffix** in that order respectively. The prefix is 1 to 4 characters (no numbers), which usually is an abbreviation of the feature code name. The identifier is the tie or pointer to the feature code file, and is identical (also with regard to case) to the feature code identifier. Identifiers in the index file do not necessarily have to match identifiers in the feature code file, however, identifiers that do match fuel automatic descriptions of station ID's. The suffix is the counter, or the number, of the next shot of a particular feature. The number is incremented automatically after every location of that particular feature. The suffix is not incremented for a particular feature until the observation has taken place. Figure 9.1 displays an example of an index file.

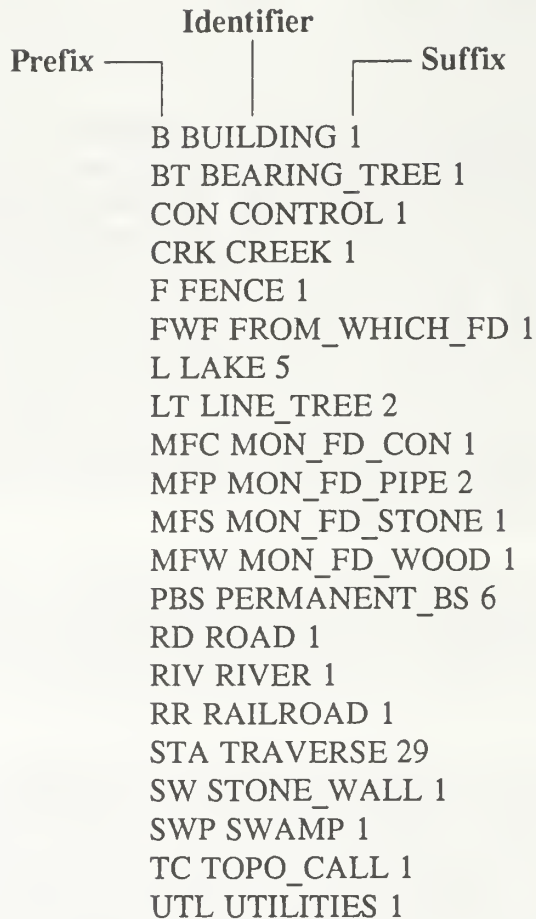


Figure 9.1: Index File

Station ID's defined through the index file combine the prefix and suffix. For example, the next location of the BUILDING, LAKE, and MON_FD_PIPE features in the index file in Figure 9.1 would be **B1**, **L5**, and **MFP2** respectively.

The **STA** prefix is a flag for simple integer station ID's, which are commonly used for traverse station ID's. The **STA** prefix is never attached in the production of the station name. The station ID becomes the suffix counter itself. For example the next shot for a TRAVERSE identifier will be **29**.

Main Module

The Main Module of CEFB has two functions that affect the index file. The Main Module appears in Figure 9.2.



Figure 9.2: Main Module

The Main Module lists the user defined files. The file pull-down menu is shown in Figure 9.3.

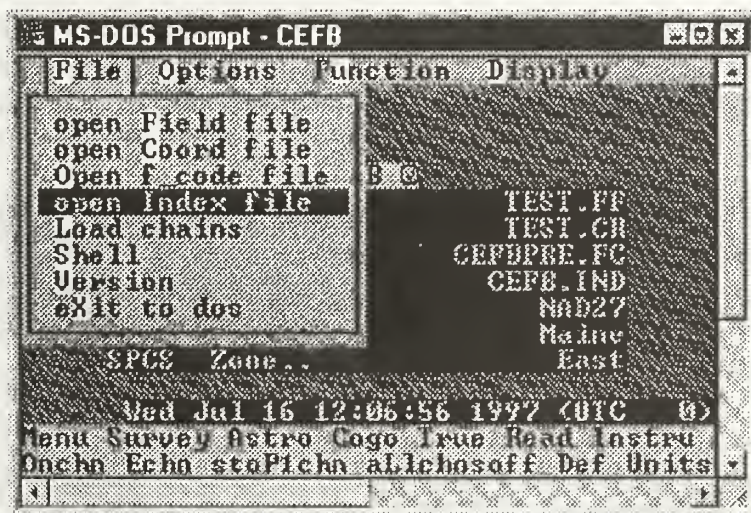


Figure 9.3: Main Module File Menu

open Index file

The 'open Index file' function shown in Figure 9.3 opens an index file and loads it into memory for automatic point indexing. The prompts for the open index file function operates in the same fashion as the other open file prompts described in Chapter Three. If errors are found in the index file during loading, an error message will notify the surveyor, and the index file will not be loaded.

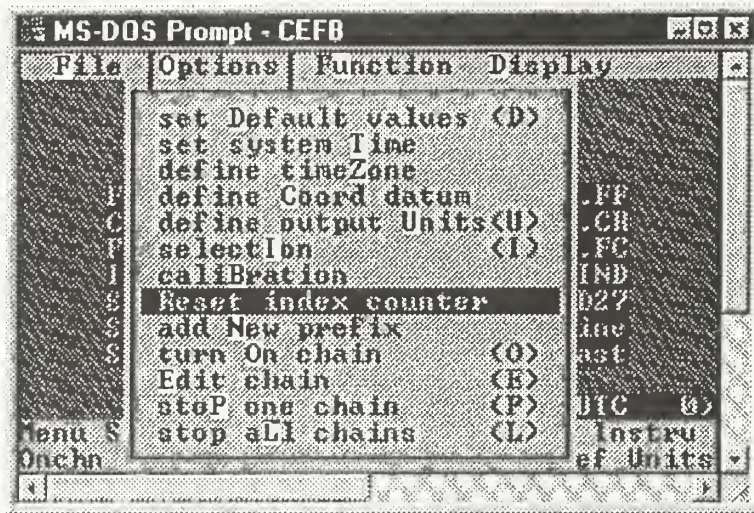


Figure 9.4: Main Module Options Menu

Reset index counter

The 'Reset index counter' function under the options pull-down menu shown in Figure 2.5 sets the suffix for all features in the index file to 1. This is usually performed at the beginning of a survey job to begin the automatic indexing of station ID's at 1. This function will only be executed if an index file is loaded. You can not set the suffix to 1 if there are no features (.fc) loaded.

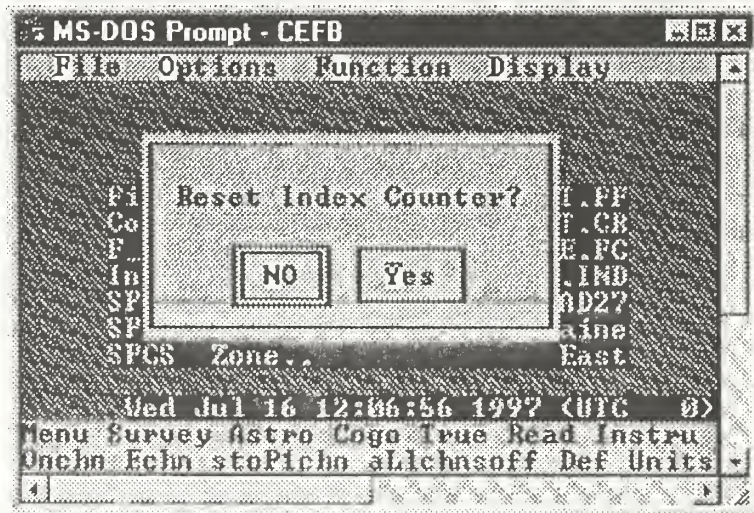


Figure 9.5: Reset Index Counter Prompt

Figure 9.5 displays the reset index counter prompt. The user then selects his or her desired choice. The yes selection resets the suffixes for all the features in the index file to one.

Survey Module

Predicting Consecutive Acceptable Index Station ID's

Anytime the index file is loaded and a surveyor performs a function that prompts for a station ID, that prompt will always attempt to predict the next consecutive station ID numerical suffix. This routine requires acceptable index station ID's in the corresponding BS, OC, and FS stations. The BS and OC stations are two fields where station ID's still usually need to be manually entered. The first prompt when initiating the Survey Module is for the back sight (BS) station. If an acceptable index station ID is entered into the BS station, CEFB will now predict the occupied (OC) station to be the next consecutive index station ID for the prefix in the BS name. For example, utilizing the index file in Table 2.1, if **B1** is entered in the BS station, **B2** will be predicted for the OC station, and consequently **B3** for the foresight (FS) station. Another example of this are the integers associated with the TRAVERSE identifier. If **1** is entered in the BS station, **2** will be predicted for the OC station, and consequently **3** for the FS station. One can also change the prefix at the OC station. For example, if **1** is entered in the BS station, **2** will be predicted for the OC station, but that **2** station ID could manually be changed in the OC station prompt to **B2**, and consequently **B3** will be predicted for the FS station.

It is very important to remember that this functionality is only a prediction, and manual input of the BS, OC, and FS stations can always override those predictions. It is also important to keep in mind that prediction of consecutive index station ID's has no bearing on the suffix for that feature in the index file. The only time a suffix for a particular feature is incremented is when an acceptable index station ID in the FS station is polled or observed.

Only character prefixes are allowed in the index file. Examples of unacceptable prefixes which will not work properly if entered are F!1, 10A, BA2, RR2A. These unacceptable prefixes can be entered and used as acceptable station names. The index file does not change the way station ID's can be manually entered and managed. However, with the addition of the index file, the surveyor can apply the prefix/suffix concept for more effective data collection.

Selecting an Indexed FS Station ID

Automatic point indexing of subsequent foresights at a setup is handled through a variety of options.

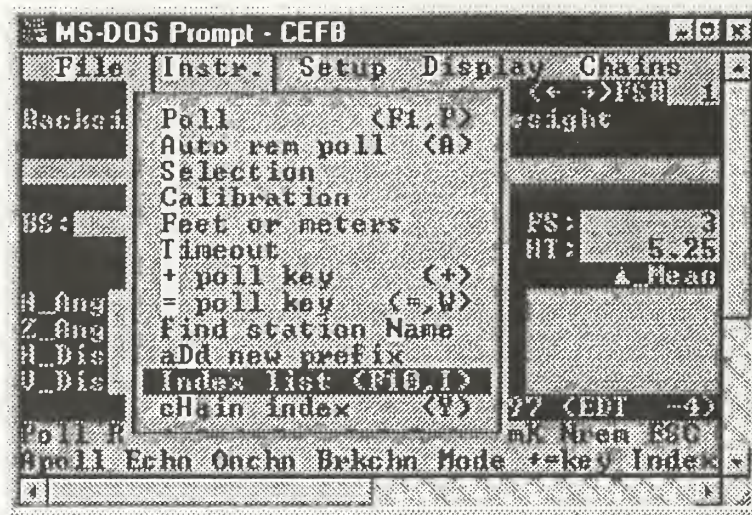


Figure 9.6: Survey Module Instrument Menu

The 'Index list' function, or the F10 or I hot keys, produces the pick list shown in Figure 9.7. The pick list displays all of the identifiers, and their associated prefixes, available in the index file. Selection of one of the features by pressing enter will produce its proper station ID, based on the feature code prefix and the latest suffix. The index pick list has the same user interface as any pick list in CEFB. Note the list can be searched alphabetically, press "R" and the first feature code beginning with "R" is found.

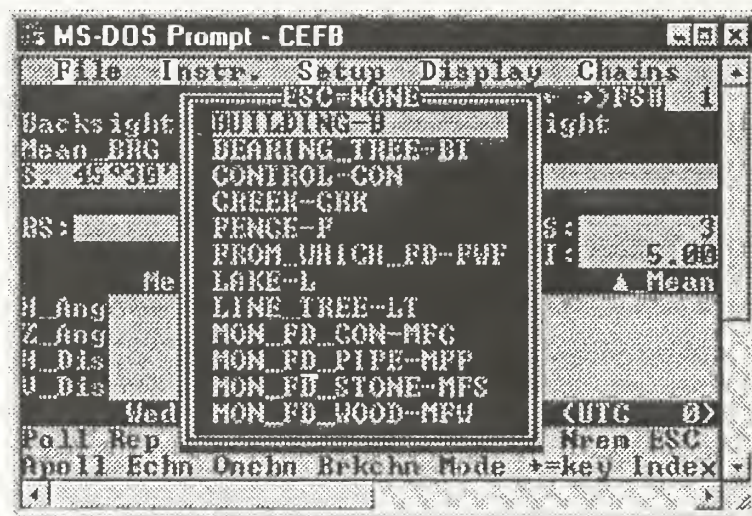


Figure 9.7: Index Pick List

Selection of the MON_FD_PIPE feature in Figure 9.7 will produce MFP2 in the FS station if the next suffix for MFP is identified as 2 in index file. Corresponding prefixes for features are shown to enable surveyors to exactly identify which feature and prefix is desired, based on the fact that surveyors can establish one or more features with different prefixes (discussed in the 'Load chains' function of Chapter Ten and the 'adding a prefix' function of this chapter).

Another method of invoking the index pick list is in the FS station prompt with the **F10** key as shown in Figure 9.8. When an index file is correctly loaded into CEFB, the FS station prompt heading will be "FS Station or F10 ?" to signify to the surveyor of the capability for generating the index pick list from that prompt.

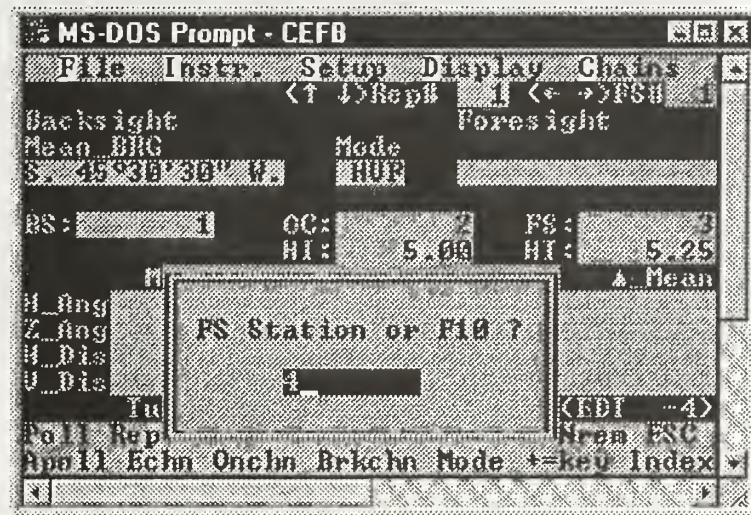


Figure 9.8: FS Station Prompt

The 'next Fs station' function in the setup pull-down, or the **F** hot key, invokes the FS station prompt shown in Figure 9.8. This allows the surveyor to define the next FS to be observed for that particular setup.

The functionality of the prediction of acceptable index station ID's is employed in this operation. Whenever the 'next Fs station' function is invoked and there is an acceptable index station ID in the FS station, CEFB will always predict the FS station to be the next consecutive index station ID. For example, if **RR5** was in the FS station, **RR6** would be predicted for the next FS station.

This does not confine the surveyor to one particular feature. The **F10** key in the edit FS station prompt discussed previously enables surveyors to select the index pick list of features. For example, if **RR5** was in the FS station, **RR6** would be predicted for the next FS station. If the surveyor, however, desired to observe a FENCE location, the **F10** key would bring up the index pick list and allow the surveyor to redefine the FS station to the FENCE feature.

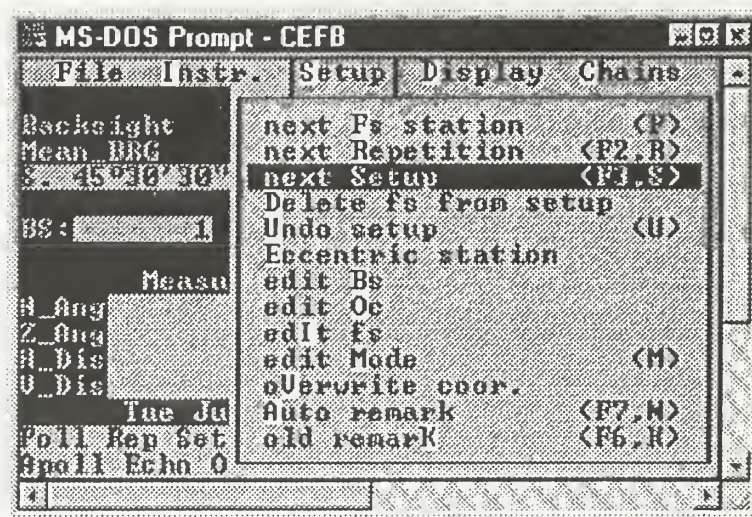


Figure 9.9: Survey Module Setup Menu

Moveup Segment of Next Setup Function

The 'next Setup' function in the setup pull-down menu shown in Figure 9.9, or the **F3** and **S** hot keys, prompts the surveyor if a new setup is desired. The surveyor is then questioned if the new setup will be a "move up" from the existing setup. The move up option is based on the logic that the new BS station is the previous OC station, the OC station becomes the previous FS station, and the FS station is prompted to the surveyor for input. This function facilitates basic traversing methods.

The disadvantage with this procedure is that the surveyor must always observe the next traverse or occupied station last in the current setup, so that the move up procedure will correctly update the BS and OC stations. For example, if the BS station is **1**, the OC station is **2**, the FS station is **MFP3**, and the surveyor has already observed station **3** (assumed to be the next desired OC station), the move up option would incorrectly position **2** in the BS and **MFP3** in the OC station.

When the index file is loaded in CEFB and there is an acceptable index station ID as the OC station, the move up option will be based on the OC station. This implies that the BS station becomes the previous OC station, the OC station becomes the previous OC station index station ID +1, and the FS station is predicted to be the previous OC station index station ID +2. Three examples of this methodology are shown below. The resulting FS stations in these examples are the predicted station ID's.

Example No.#1	<u>BS</u>	<u>OC</u>	<u>FS</u>
Original Setup	11	12	13
New Setup after Move Up	12	13	14
Example No. #2	<u>BS</u>	<u>OC</u>	<u>FS</u>
Original Setup	11	12	MFP3
New Setup after Move Up	12	13	14

Example No. #3	BS	OC	FS
Original Setup	F1	F2	RD1
New Setup after Move Up	F2	F3	F4

The first two examples contain integer station ID's from the TRAVERSE identifier of the index file. The resulting OC station is the previous OC station + 1 or 13, and the resulting predicted FS station is the previous OC station + 2 or 14 in both examples. The same is true for the third example, where the resulting OC station is the previous OC station + 1 or F3, and the resulting predicted FS station is the previous OC station + 2 or F4.

This move up procedure is based on the concept that the OC prefix will remain the same and increment by one, and the FS prefix will remain the same feature as the OC prefix and increment by two. This does not occur all the time in the field, but it does allow surveyors to collect traverse and sideshot data in any order without a FS station becoming an undesired OC station in the move up option. This concept works best if a surveyor bases his next step on the occupied station name prefix + 1. This would normally be the first foresight at a setup.

Automatic Descriptions

If the FS station is an acceptable index station ID, the surveyor has already identified what feature the FS station is and should not have to scroll through the feature code pick list to execute a description for the that station. The 'Auto remark' function, or the F6 or N hot keys, automatically executes the feature code corresponding to the FS station prefix and attaches it to that station. If there is not a corresponding identifier in the feature code file, or an acceptable index station ID in the FS station, the generic description pick list functionality (normally accessed by the K hot key) is performed.

The 'old remark' function, or the F7 or K hot keys, displays a pick list of available feature codes in the feature code file. Before this occurs the surveyor is asked to define the station to attached the remark to. This prompt is shown in Figure 9.10.

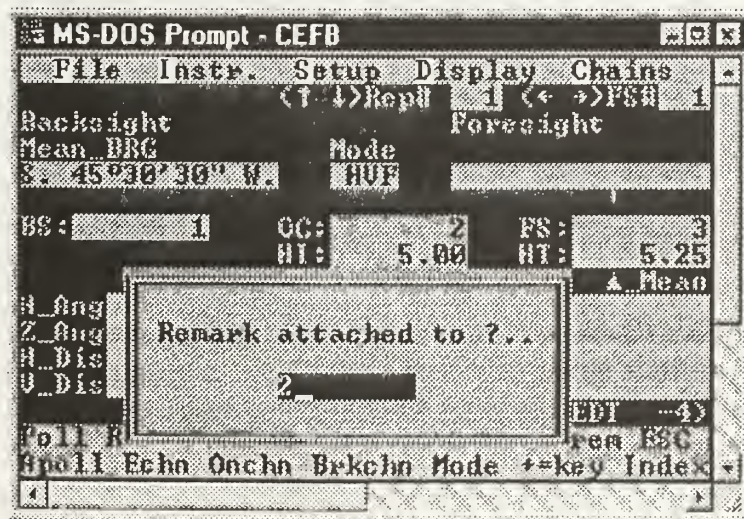


Figure 9.10: Attach Remark Prompt

The default station (attach remark to default of occupied or foresight station) for the prompt in Figure 9.10 can be defined in the 'set Default values' function discussed in Chapter Three. The 'set Default values' function stores several parameters utilized in CEFB in a configuration (.cf) file which is initialized at the onset of CEFB. The OC and FS stations are the most common described stations at the time of description execution, and gives the surveyor the ability to define one of the two fields as the default station. The prompt is shown in Figure 9.11.

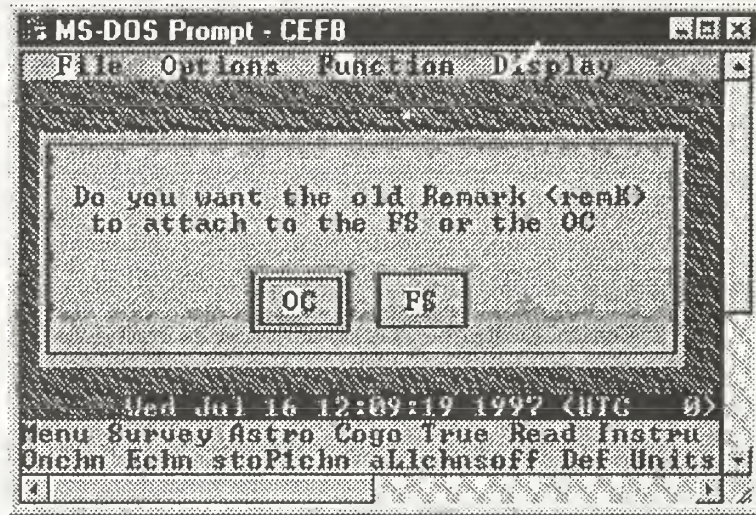


Figure 9.11: Attach Old Remark Default Station Prompt

Apoll

Observing and describing an acceptable index station ID in the FS station requires two keystrokes, the **P** for **Poll** hot key and then the **N** for **Nrem** (New Remark) hot key. The 'Auto rem poll' function, or the **A** hot key, reduces the require amount of keystrokes to one. The 'Auto rem poll' function has the same functionality as the 'Poll' function except that the 'Auto remark' function is immediately executed after the instrument is polled. This allows surveyors to automatically describe the FS station based on the feature code.

The + or = Hot key

There are several instances in the field when a surveyor is collecting consecutive observations of the same feature from one occupied station. Examples of this could be the collection of several shots along a fence, road centerline, edge of pavement, top of fill, or a meander line. These scenarios are generally associated with the collection of chains (linework) but can also be consecutive point feature codes. The '+ poll key' function polls the instrument for measurements and increment an acceptable index FS station automatically. The + hot key cannot increment a different feature's suffix as it assumes that you are locating the same feature. The only condition of the + hot key is that there has already been a set of measurements recorded for the first station ID of that feature. The + key substitutes for the F10 and poll keystrokes.

As an example, assume a surveyor needs to locate a portion of a shoreline of a pond from one particular station. The surveyor utilizes the procedures described above to select the WATER feature from the index file and automatically place W1 in the FS station. The surveyor then points and polls the instrument locating W1. The rod person moves to the next location. Now that the first observation has been taken, the surveyor points the instrument and selects the + key. The instrument is polled and the FS station is incremented automatically to W2. This process can be repeated as many times as one chooses. The + hot key gives the surveyor the ability to collect data very efficiently, thus keeping the rod person quite busy.

The '= poll key' function, or the = or W hot keys, is the Apoll equivalent of the + hot key. The = hot key has the same functionality as the + hot key except that in addition the corresponding feature code for the FS station is automatically executed after the instrument has been polled.

Adding a New Prefix

During the course of a survey, it might be desirable to add a prefix to the existing index file in the field. A particular feature needed during the survey might not be included in the index file, or one might need to create another prefix for the same identifier to facilitate locating two chains of the same feature simultaneously (discussed in Chapter Ten). The 'aDd new prefix' function provides the ability to add elements to the index file. The 'aDd new prefix' function has three segments. The first segment defines the new prefix, the second segment selects or defines the identifier, and the third segment defines whether to activate the new prefix and identifier for chain collection. Figure 9.12 displays the first segment of the 'aDd new prefix' function.

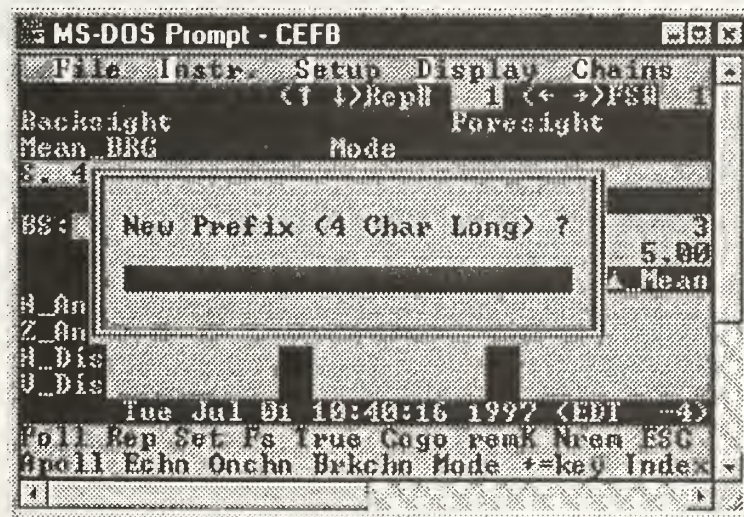


Figure 9.12: New Prefix Prompt

Allowable prefixes are no more than 4 characters, do not contain integers, and do not equal any previous prefixes. Any prefixes entered that do not meet the prior criteria will not be accepted.

After the new prefix is defined, the second segment of the 'aDd new prefix' function displays a pick list, similar to the one shown in Figure 9.7, of existing identifiers in the feature code file. This allows the surveyor to attach the new prefix to one of the existing features. If that is not preferred, the **ESC** key permits definition of a new identifier manually. The new identifier prompt is shown in Figure 9.13.

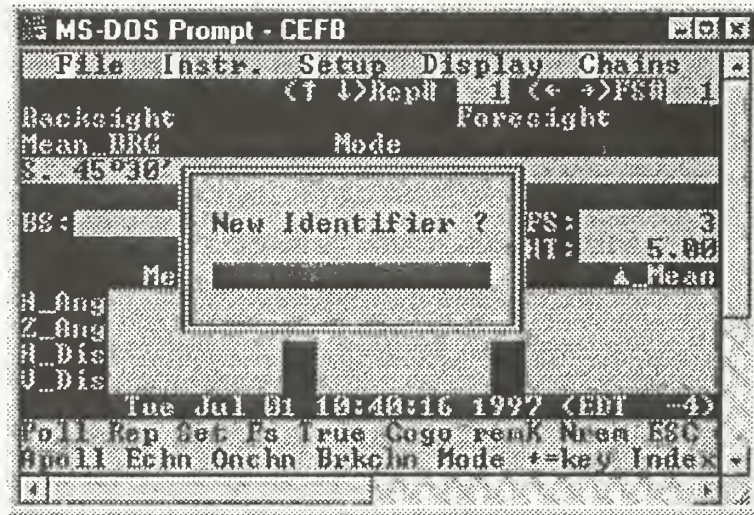


Figure 9.13: New Identifier Prompt

Identifiers in the index file do not have to match identifiers in the feature code file, however, it is important to remember that if the surveyor does not select one of the existing features in the feature code file automatic descriptions will not be available for the new identifier. The pick list of existing identifiers in the feature code file is displayed first to encourage their selection.

The third segment of the 'aDd new prefix' function is shown in Figure 9.14. The surveyor is asked to define whether to activate the new prefix and identifier for chain collection. If the surveyor does activate chain collection he or she must then define whether the chain is initially straight or curved as shown in Figure 10.3. These aspects of chain collection will be detailed in Chapter Ten.

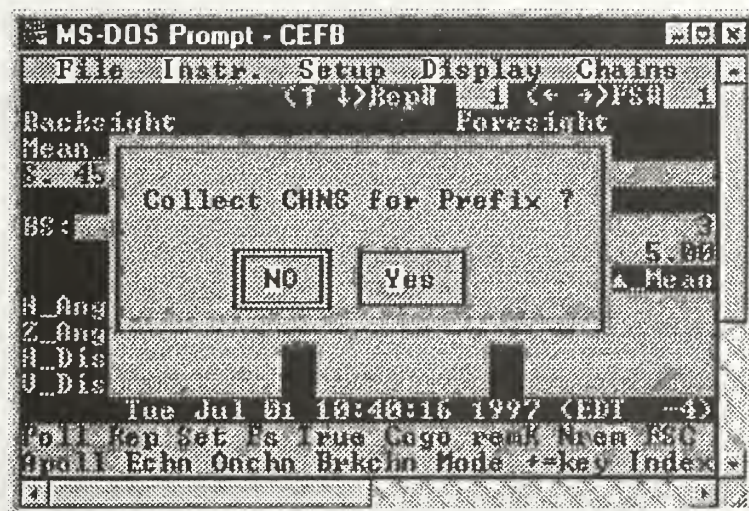


Figure 9.14: Collect Chains for New Prefix Prompt

CHAPTER TEN - CEFB - Chain Collection

Overview

Defining line work or chains is a very significant aspect of the complete process of producing final survey products. A chain is a list of station ID's which define a line. The capability of chain collection has been implemented into CEFB.

Chains are defined and driven by the features in the index file. Features are initially turned off for chain collection from the onset of CEFB. Functions described in this chapter are only performed when there is at least one feature activated for chain collection. The chains menu is shown in Figure 10.1.

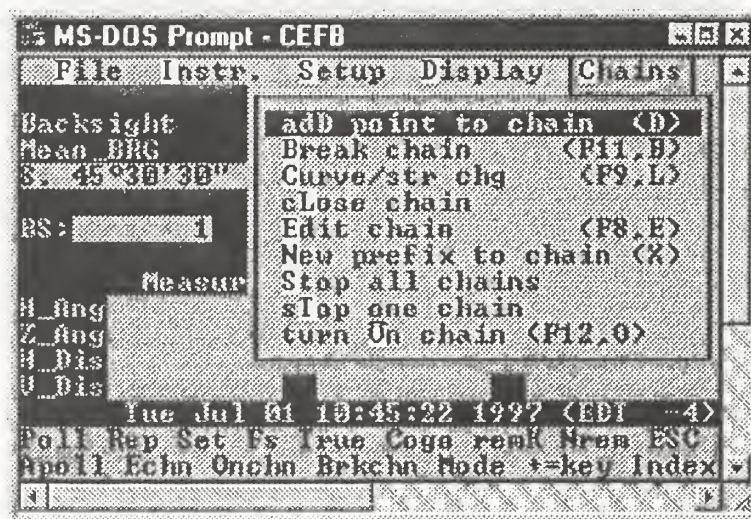


Figure 10.1: Survey Module Chains Menu

The basic principle behind chain collection is that the FS station prefix is always linked to its feature specified in the index file. When an acceptable index FS station ID is observed, excluding repetitions to it, and that particular feature is activated for chain collection, that station ID is appended to that particular feature's chain list of station names. For example, if the FENCE feature is activated for chain collection and F1 is in the FS station, once the instrument is polled and the measurements have been recorded F1 will be appended to the FENCE chain.

Features once activated for chain collection are linked to a chain string. The chain string contains station ID's identifying the linework of the particular feature. Chain strings can comprise one or more actual chains defined in the string. Individual chains are divided in a chain string by the 0 (pen up) character. Figure 10.2 displays an example of a FENCE chain string with three chains in it.

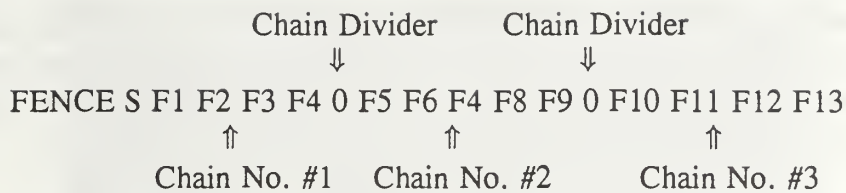


Figure 10.2: Chain String

Activating Chains

Features are activated for chain collection with the 'turn On chain' function, or the **O** hot key. The 'turn On chain' function displays a pick list shown in Figure 9.7 of all features in the index file that currently have chain collection inactivated. If a feature is selected in the pick list, it is activated for chain collection. A maximum of twenty five chain features can be collected simultaneously.

Each point in a chain is defined as a straight or curved point. This enables the **DXF** program to recognize straight line or curved portions of the chain when producing a DXF file for AutoCad. This strategy is accomplished with the **S** for straight and **C** for curve characters. When a feature is activated for chain collection, the surveyor is always prompted to define whether the chain is initially straight or curved. The straight or curved prompt is shown in Figure 10.3.

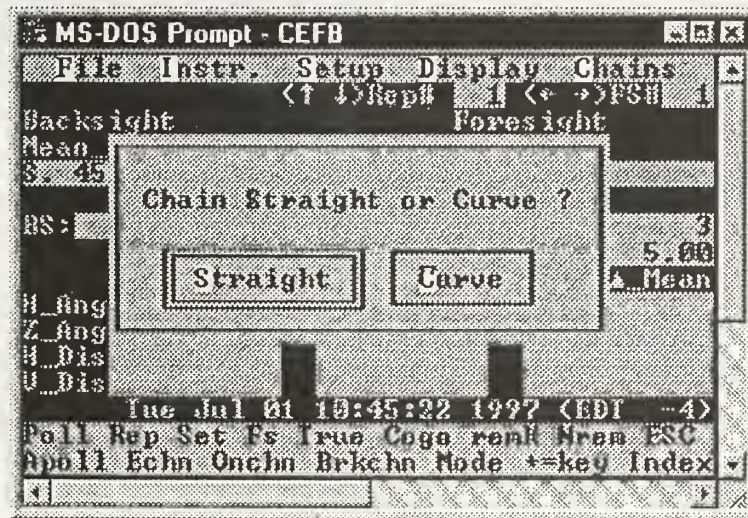


Figure 10.3: On Chain Straight/Curve Prompt

Straight/Curve Chain Points

Below are two examples of chain strings utilizing the **S** and **C** characters to define curve portions of the chain for the RAILROAD feature.

Example No. #1

S RR1 RR2 RR3 RR4 C RR5 S RR6 RR7 RR8 RR9 0 RR10 0

Example No. #2

S RR1 RR2 RR3 RR4 C RR5 RR6 RR7 S RR8 RR9 RR10 0

The **S** and **C** characters apply throughout the chain string. Station ID's in the chain string are defined as straight or curved depending on the last **S** or **C** character in the chain string. Example No. #1 is a single point curve (two tangents and a point on a curve uniquely defines the curve geometry), while example No. #2 is an multiple point curve.

The 'Curve/str chg' function, or the **F9** and **L** hot keys, prompts the surveyor to define the type of points to be collected (Straight or Curved). The Straight/Curve Prompt is shown in Figure 10.4. No function is performed if the **ESCAPE** option is selected.

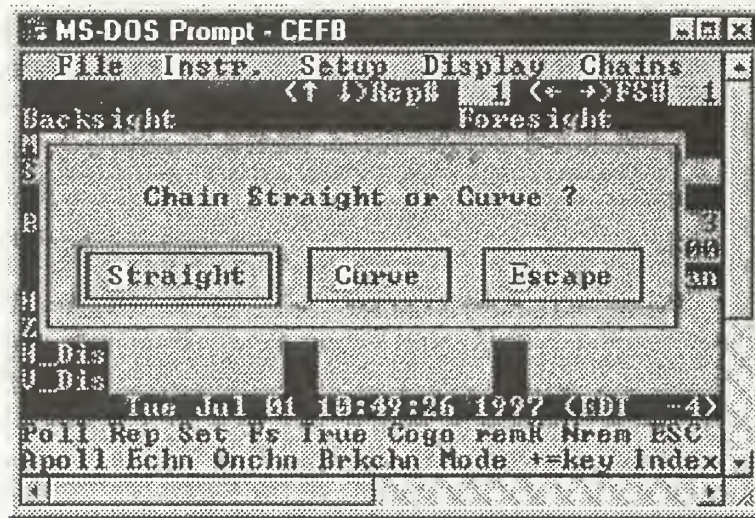


Figure 10.4: Straight/Curve Prompt

When the **Straight** or **Curve** option is selected in the prompt in Figure 10.4, a pick list containing activated chains is displayed. The surveyor can then select which chain has the corresponding **S** or **C** character appended to it.

Edit chain

The ability to manually observe, edit, and manipulate chains in the field are fundamental functions that are required to make chain collection feasible and efficient. The 'Edit chain' function, or the **F8** or **E** hot keys, displays a pick list shown in Figure 10.5 of activated chain collection features in the index file.

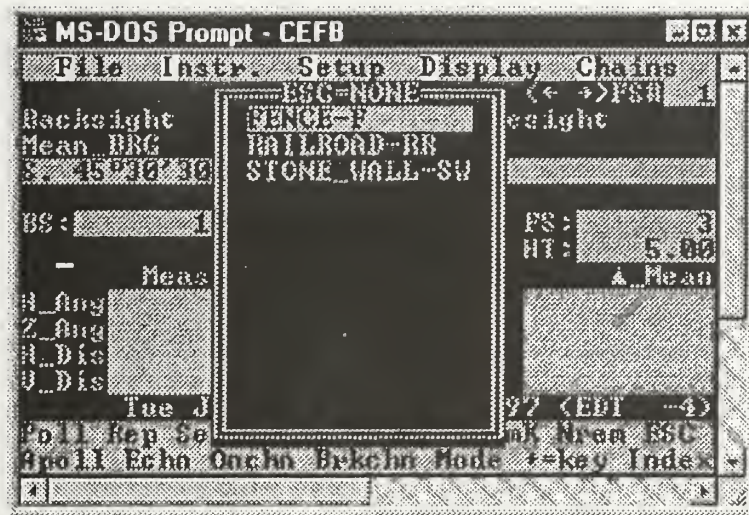


Figure 10.5: Edit Chain Pick List

If a selection is made, an edit window containing the existing chain will appear, allowing the surveyor to edit the chain string in any fashion. Figure 10.6 displays a chain string which has just been activated and been defined as straight. For this example, let's say the FENCE feature is activated.

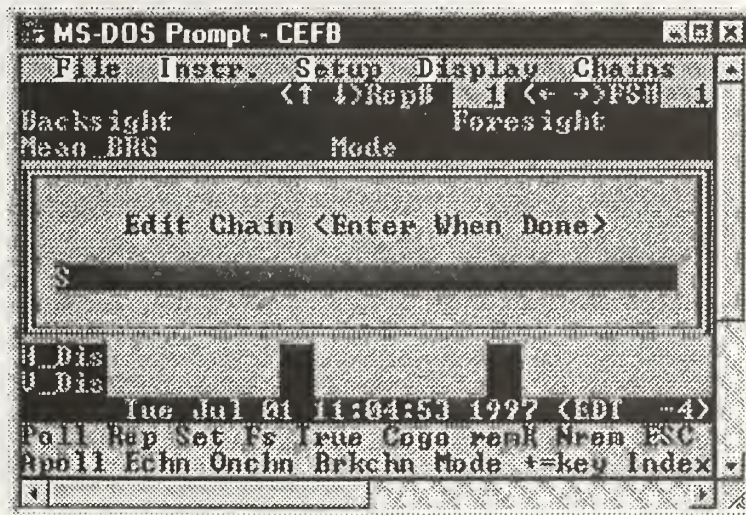


Figure 10.6: Edit Chain Window New Chain

Once FENCE points with the F prefix have been collected, the FENCE chain string might look something like Figure 10.7.

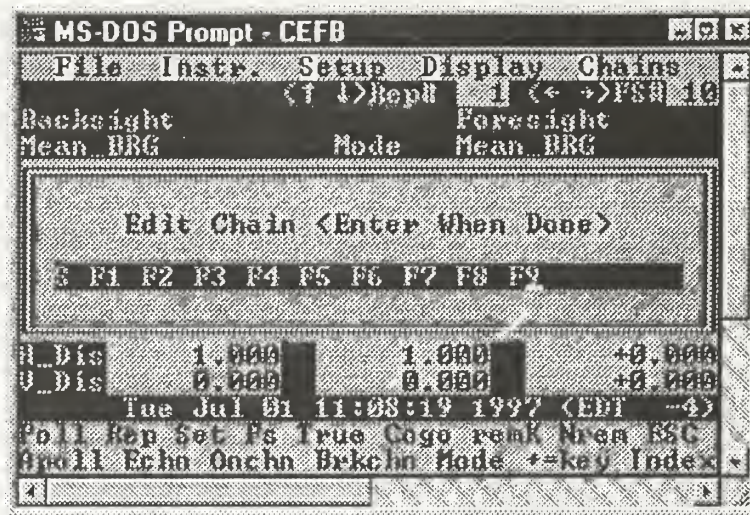


Figure 10.7: Edit Chain Window Collected Chain

Chain strings can contain up to 500 characters, however, based on the length of the CEFB screen, the edit chain window is limited to 36 characters. Figure 10.8 displays an FENCE chain string longer than 36 characters.

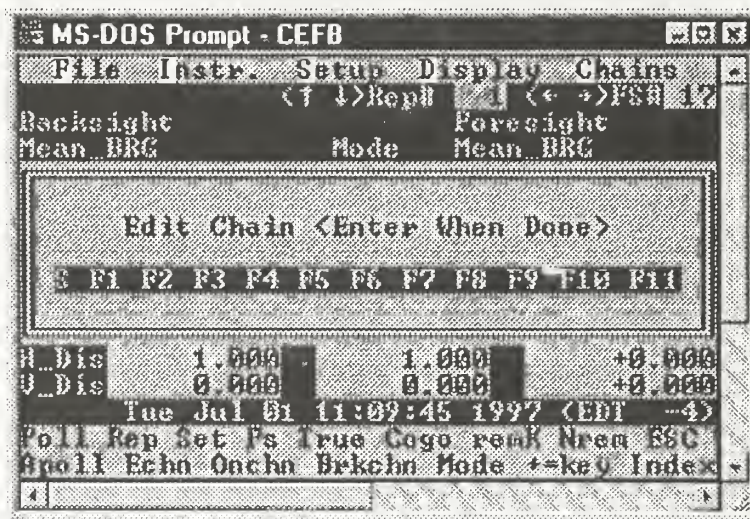


Figure 10.8: Edit Chain Window Chain Longer than 34 Characters

When the example in Figure 10.8 occurs, there are several editing keys that facilitate elementary editing. The **right** and **left** arrow keys allow the surveyor to scroll up and down the chain string to get to the desired location. The **HOME** and **END** keys places the cursor at the beginning and end of the chain string, and the **BACKSPACE** and **DELETE** keys also work accordingly. Figure 10.9 displays a FENCE chain string longer than 36 characters with the cursor located at the end of the chain string.

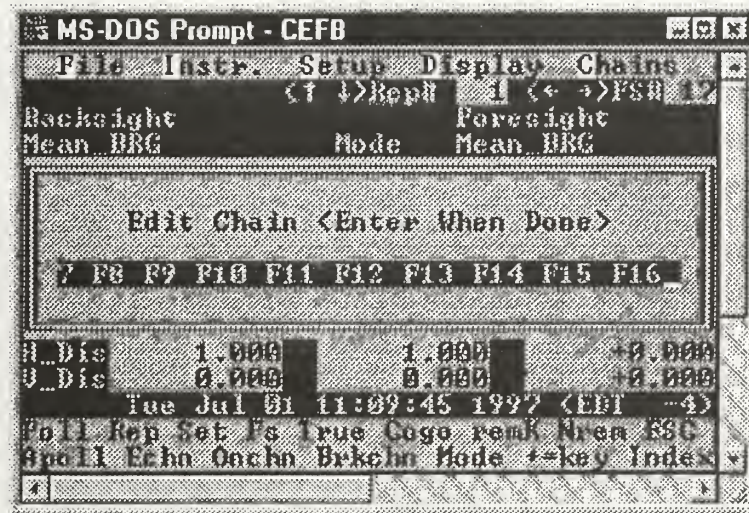


Figure 10.9: Edit Chain Window Cursor at End of Chain String

As the header states in the edit chain window, the enter key returns the surveyor to the Survey Module once editing has taken place. Also because the number of chains in a chain string can change after editing, the edited chain string is scanned to reaffirm the number of chains in it.

There are two situations where stations are appended to a chain string. The first is when station ID's are located in the Survey Module and the second is in the edit chain window. Remember, chain strings are limited to 500 characters. There are therefore two traps to verify the allowable chain string length. While in the edit chain window, once the surveyor exceeds the allowable length of 500 the message displayed in Figure 10.10 notifies the surveyor, and then exits out of the edit chain window.

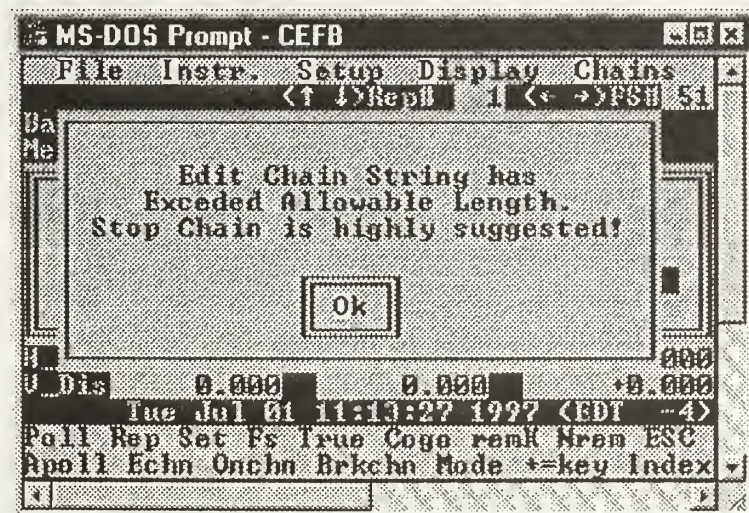


Figure 10.10: Edit Chain Window Exceeding Allowable Chain String Length

The same check is implemented into the Survey Module when collecting station names into the chain string. If the surveyor exceeds the allowable length of 500 the message in Figure 10.11 is displayed.

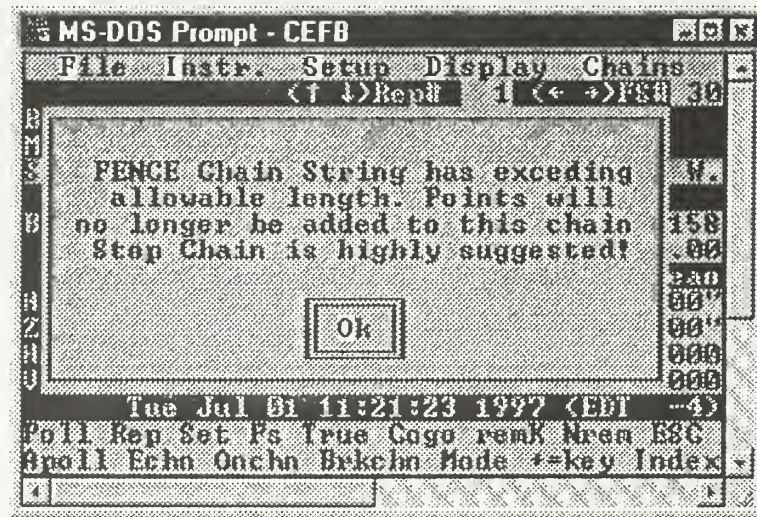


Figure 10.11: Exceeding Allowable Chain Length

Both messages displayed in Figures 10.10 and 10.11 highly suggest to the user to use the stop chain function(s). This function is suggested because the chain string can no longer be manipulated. The ‘stop chain’ function(s), and further discussion of the structure of the chain (.chn) file, will be discussed later in this chapter.

Break Chain

Figure 10.2 displayed a typical chain string containing three chains divided or broken by the **0** character. The 'Break chain' function, or the **F11** or **B** hot keys, appends the **0** character to the specified chain string and enables the surveyor to begin a new chain. The initial prompt of the break chain function is displayed in Figure 10.12.

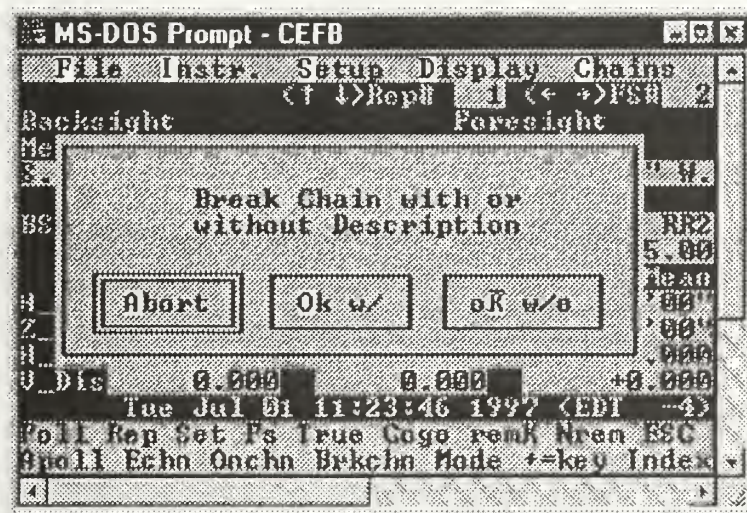


Figure 10.12: Break Chain Prompt

The prompt shown in Figure 10.12 allows the surveyor to break the chain with or without describing the chain prior to the break. If the surveyor selects one of the OK options in the prompt shown in Figure 10.12, a pick list is introduced displaying all active chain features. The surveyor can then select which chain feature he or she wishes to break, keeping in mind the ESC key aborts the function. A typical pick list of activated chain features is shown in Figure 10.13.

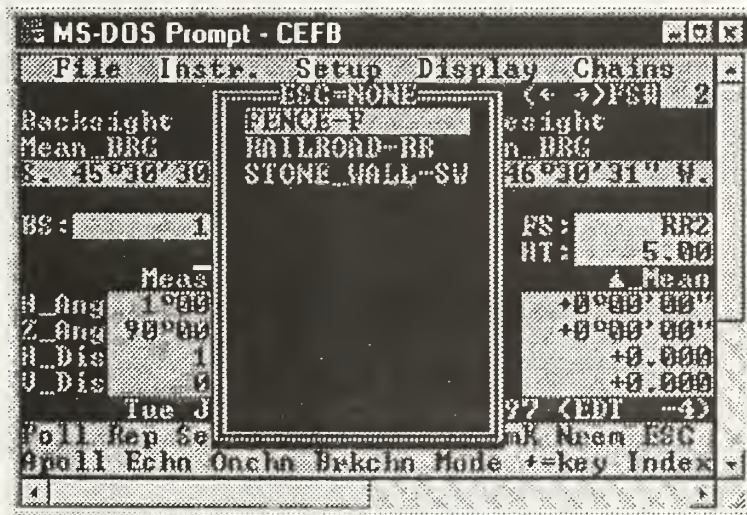


Figure 10.13: Break Chain Pick List

If the surveyor chooses to break chain with description, the chain string's associated feature code is executed and written to the chain (.chn) file. The 'Break chain' function will affect the FENCE chain string shown in Figure 10.7 in the following fashion.

S F1 F2 F3 F4 F5 F6 F7 F8 F9 0

cLose chain

The 'cLose chain' function in the chains pull-down menu is very similar to the 'Break chain' function. The difference is the current chain is closed upon itself, or in other words the first station ID of the current chain and the 0 character are appended to the chain string. The initial prompt of the 'cLose chain' function is shown in Figure 10.14.

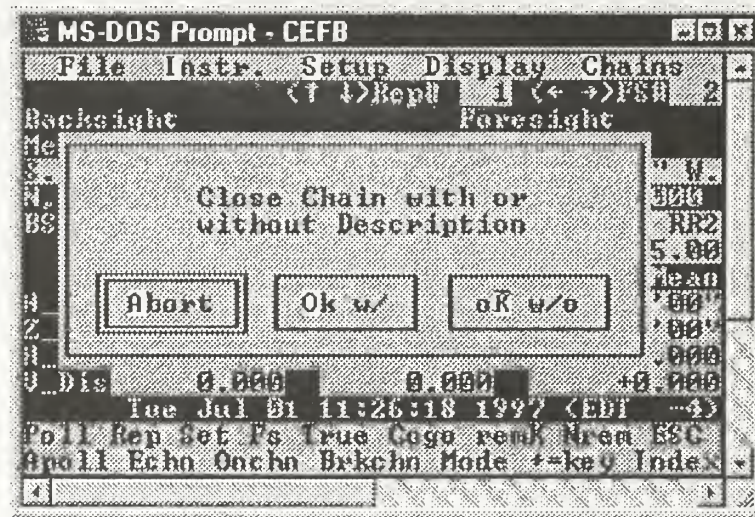


Figure 10.14: Close Chain Prompt

The prompt shown in Figure 10.14 allows the surveyor to close the chain with or without describing the chain. If the surveyor selects one of the OK options in the prompt shown in Figure 10.14, a pick list is introduced displaying all active chain features. The surveyor can then select which chain feature he or she wishes to close, keeping in mind the **Esc** key aborts the function. If the surveyor chooses to close the chain with a description, the chain string's associated feature code is executed and written to the chain file. A typical pick list of activated chain features is shown in Figure 10.13. The 'cLose chain' function will affect the FENCE chain string shown in Figure 10.7 in the following fashion.

S F1 F2 F3 F4 F5 F6 F7 F8 F9 F1 0

The 'cLose chain' and 'Break chain' functions can not be executed on empty or null chains. Below are two examples of an empty or null chain:

Chain No. #1 ——— Chain No. #2

Example No. #1: S F1 F2 F3 F4 F5 F6 0

Example No. #2: S

———— Chain No #1

Chain No. #2 is the active chain in the example No. #1 chain string. It does not contain any points. Until it does it is considered an empty or null chain. You would not want to break or close a chain without any points in the chain. The same is true for example No. #2.

cHain index

When surveyors are collecting observations for multiple chains or linework, often that is the only function the surveyor is performing. The surveyor does not want to search through an extensive index file pick list if he or she is just interested in the active chain feature prefixes. For example, a surveyor is collecting ROAD, CURB, and EDGE_PAVEMENT chains simultaneously. When the surveyor is collecting station ID's for one of the three active chain features, the + key efficiently collects and increments station ID's for that chain. When the surveyor desires to change the station ID to one of the other active chain features, the I or F10 hot keys displays a feature/prefix pick list from the index file. Even with the alphabetic functionality of pick lists in CEFB, the time required to find active chain feature prefixes in an extensive index file pick list is much slower than if the pick list only contained active chain feature prefixes.

The 'cHain index' function, or the Y hot key, displays a pick list from the index file of only active chain feature/prefixes instead of the entire index file.

New prefix to chain

When collecting chains or linework in the field, there are instances when surveyors might desire to insert a different prefix station ID into a chain string other than the prefix associated with the chain feature. If a surveyor is collecting a FENCE chain, station ID's with the F prefix are associated and inserted into that chain string. However, the surveyor might desire to insert, for example, STONE_WALL station ID's with the SW prefix into the FENCE chain string. The New Prefix to Chain function in the chains pull-down menu, or the X hot key, redefines the prefix associated with a chain feature. Figure 10.15 displays a typical list of activated chains and their associated prefixes.

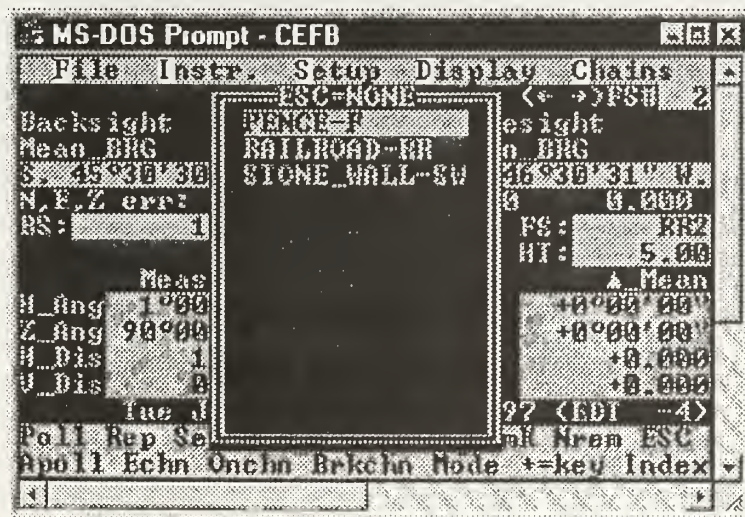


Figure 10.15: New Prefix to Chain Prompt

The initial prompt of the 'New prefix to chain' function, or the X hot key, is shown in Figure 10.15. The surveyor can then select which activated chain he or she wishes to associate the prefix with. The surveyor is then asked to define what new prefix to associate with the selected chain feature. This step is shown in figure 10.16



Figure 10.16: New Prefix to Chain Pick List

Selection of the SW prefix for the FENCE chain will affect the activated chain list as shown in Figure 10.17.

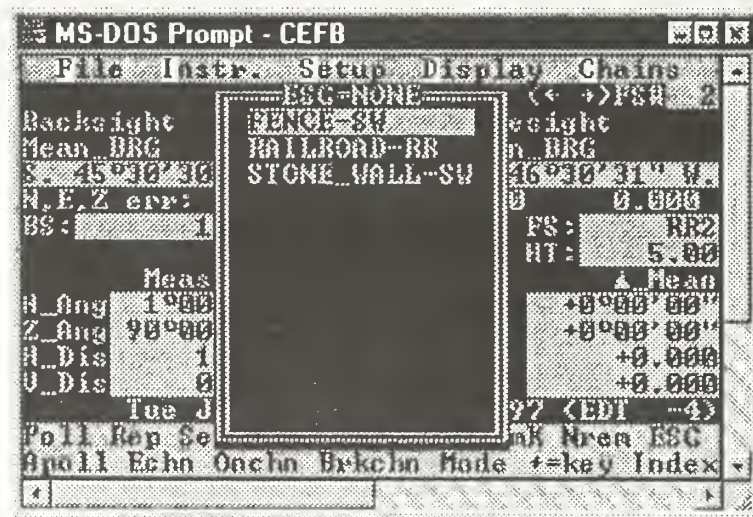


Figure 10.17: New Active Chain List

The active chain list shown in Figure 10.17 signifies the SW prefix will be appended to the FENCE and STONE_WALL chain strings when observed as the FS station ID. This is because the surveyor has associated the SW prefix to both FENCE and STONE_WALL active chain features. Surveyors can, also, associate inactivated chain feature prefixes to activated chain features. For example, the surveyor might desire to associate the MF prefix for MON_FD to the FENCE chain feature. This scenario would affect the active chain list as shown in Figure 10.18.



Figure 10.18: Active Chain List

With the SW prefix associated to the FENCE chain feature, collection of two SW station ID's will affect FENCE chain string shown in Figure 10.7 in the following fashion.

S F1 F2 F3 F4 F5 F6 F7 F8 F9 SW1 SW2

add point to chain

Similar to the 'New prefix to chain' function, there are several instances when the surveyor desires only to change the prefix associated with a chain feature for only one point. For example, when collecting a FENCE chain, the surveyor might come across a monument in the fence line. The surveyor does not want to perform the 'New prefix to chain' function for just one point, instead he or she just wants to add the MF station ID to the FENCE chain string. The 'add point to chain' function, or the D hot key, enables the surveyor to add the FS station ID to a specified chain feature. The 'add point to chain' function will display the prompt shown in Figure 10.19.

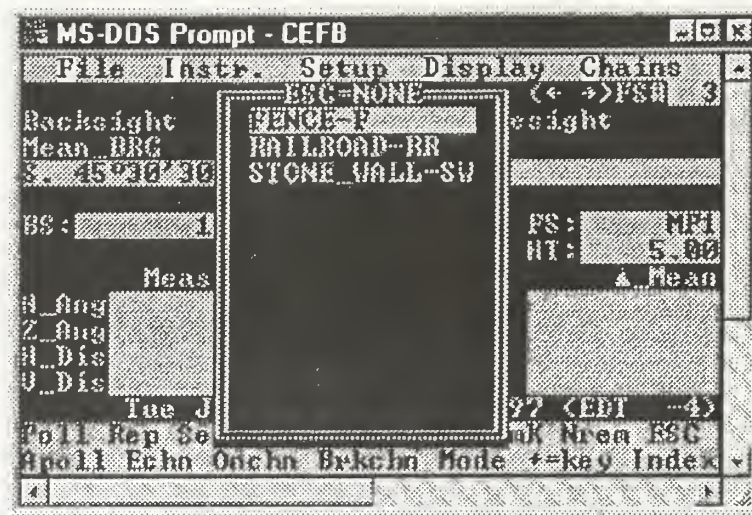


Figure 10.19: Add Point to Chain Prompt

Selection of the FENCE chain feature in Figure 10.19 will affect the chain string shown in Figure 10.7 in the following fashion.

S F1 F2 F3 F4 F5 F6 F7 F8 F9 MF1

Stop Chain Functions

The stop chain functions simply inactivates chain collection. The 'sTop one chain' function inactivates one chain feature while the 'Stop all chains' function inactivates all chain features. The 'sTop one chain' function displays a pick list of active chain features. If a chain feature is selected, it is turned off for chain collection and the corresponding chain string and description are written to the chain file. Corresponding feature code descriptions are only executed when the active chain in the selected feature chain string is not empty or null.

The 'Stop all chains' function performs the same steps described above in the 'sTop one chain' function, except the pick list of active chain features is not necessary. Instead a yes/no prompt appears to the surveyor ensuring this is really what he or she wants to do. The 'Stop all chains' function prompt is shown in Figure 10.20. In this case all feature code descriptions for each chain are executed.

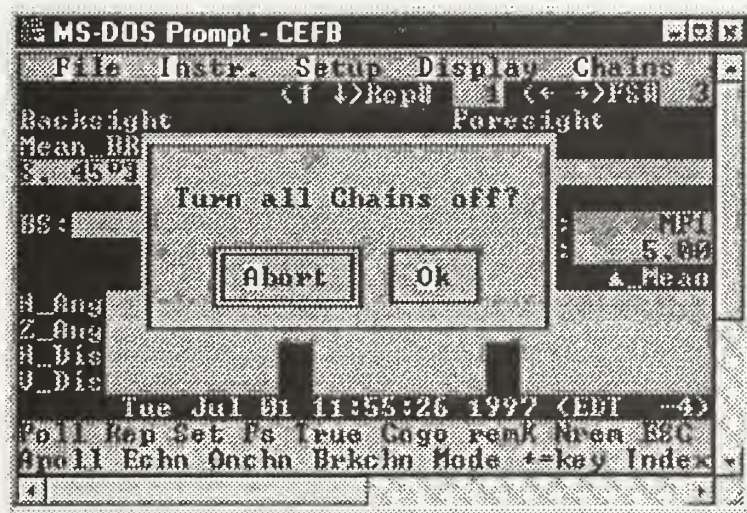


Figure 10.20: Stop All Chains Prompt

The Chain File

The chain (.chn) file contains feature chain strings and descriptions of the chains within a chain string. The chain file is defined as the linework field file with a **.CHN** extension. Descriptions for chains have a **No.** attached corresponding to the chain number within the chain string for that chain feature. Figure 10.21 displays a typical example of a CEFB produced chain file.

```
BUILDING No. #1: Boardman Hall on UMaine campus
BUILDING No. #2: Barrows Hall on UMaine campus
FENCE No. #1: Chainlink fence
FENCE No. #2: Wood Post fence
FENCE No. #3: Picket fence
BUILDING S B1 B2 B3 B4 B1 0 B5 B6 B7 B8 B5 0
FENCE S F1 F2 F3 C F4 S F5 F6 0 F7 F8 F9 0 F10 F11 F12 0
```

Figure 10.21: Chain File Example

The BUILDING chain string has two separate chains which close upon themselves with two corresponding descriptions while the FENCE chain string has three separate chains with three corresponding descriptions. The **0** character separates the chains within the chain strings. **F4** is on a curve because of the **C** character before **F4**.

Descriptions of chains are always going to be above their matching chain strings in the chain file. This can be important when there are two or more chain strings for the same feature. Figure 10.22 illustrates a chain file with two chain strings of the same feature.

BUILDING No. #1: Boardman Hall on UMaine campus
 BUILDING No. #2: Barrows Hall on UMaine campus
 FENCE No. #1: Chainlink fence
 FENCE No. #2: Wood Post fence
 FENCE No. #3: Picket fence
 BUILDING S B1 B2 B3 B4 B1 0 B5 B6 B7 B8 B5 0
 FENCE S F1 F2 F3 C F4 S F5 F6 0 F7 F8 F9 0 F10 F11 F12 0
 FENCE No. #1: Barb Wire fence
 FENCE No. #2: Virginia Rail fence
 FENCE S F13 F14 F15 MF1 F16 0 F17 F18 C F19 S F20 F21 0

Figure 10.22: Chain File Example

Load chains

Features may also be activated for chain collection with the 'Load chains' function in File pull-down menu of the Main Module shown in Figure 9.3. This can be very useful when the surveyor desires to append or edit additional information to a chain string already written to the chain file. The 'Load chains' function reads a specified chain file and prompts the surveyor to define which existing chain strings in the chain file need to load into CEFB. To illustrate specifically how the 'Load chains' function operates, the chain file in Figure 10.22 will be loaded. Figure 10.23 displays the initial prompt of the 'Load chains' function which is a pick list of available chain file with .CHN extension in the current directory. Like other file prompt functions the surveyor has the ability to escape out of the pick list and manually define the chain file.



Figure 10.23: Chain File Prompt

Once the chain file is defined, CEFB scans the descriptions and chain strings, and then prompts the surveyor regarding each chain string found in the chain file. Based on the chain file in Figure 10.22, the 'Load chains' function will prompt the surveyor to load (or not load) the BUILDING chain as shown in Figure 10.24.

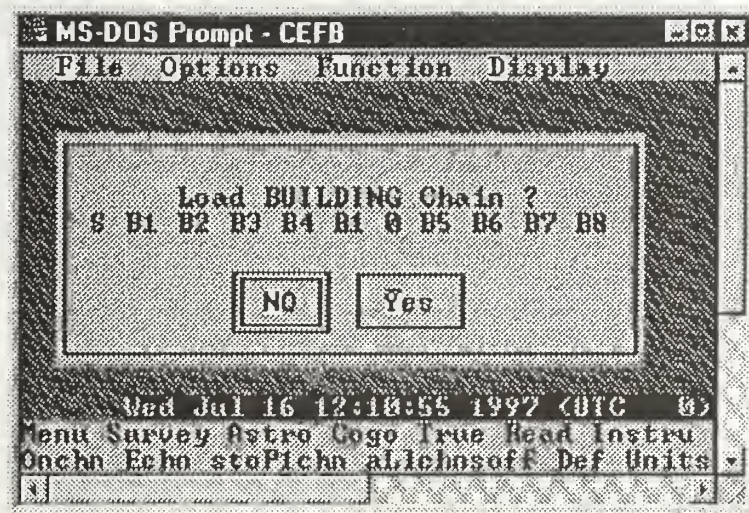


Figure 10.24: Load BUILDING Chain

Up to 30 characters of the chain string are displayed in the prompt to assist in the identification of the chain string. If approval is given and there is only one matching identifier in the index file the chain string will be immediately activated for that identifier. For example, the BUILDING chain string in Figure 10.24 would be activated and associated with the BUILDING identifier in the index file. If there are two or more matching identifiers in the index file, a pick list will display the common identifiers, and the associated prefixes, enabling the surveyor to select what identifier to associate the chain string to. As discussed previously in this chapter, identifiers can exist in more than one location in the index file with differing prefixes. This provides surveyors the ability to locate chains of the same feature simultaneously based on the different prefixes. For example, a surveyor desires to locate two BUILDING chains simultaneously. Using the 'aDd new prefix' function, the surveyor defines the **BB** prefix to the BUILDING identifier in the index file. After this function the index file would have two BUILDING identifiers, one with the **B** prefix and the other with the **BB** prefix, enabling the surveyor to simultaneously locate two separate BUILDING chain strings with their respective prefixes. If the index file had two BUILDING identifiers as discussed, the load BUILDING chain prompt if accepted would display the pick list shown in Figure 10.25 enabling the surveyor to select a prefix to associate the chain string to.

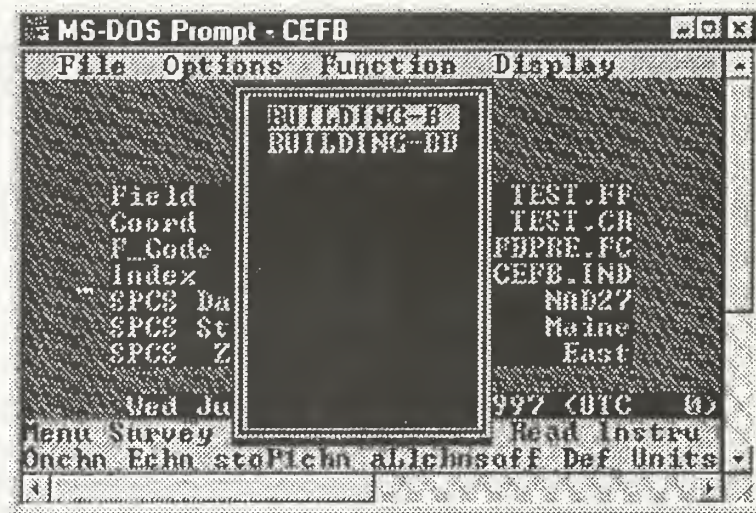


Figure 10.25: Load Chain Pick List

The 'Load chains' function would then prompt the surveyor for activation of the first FENCE chain string in the chain file in Figure 10.22 as shown in Figure 10.26.

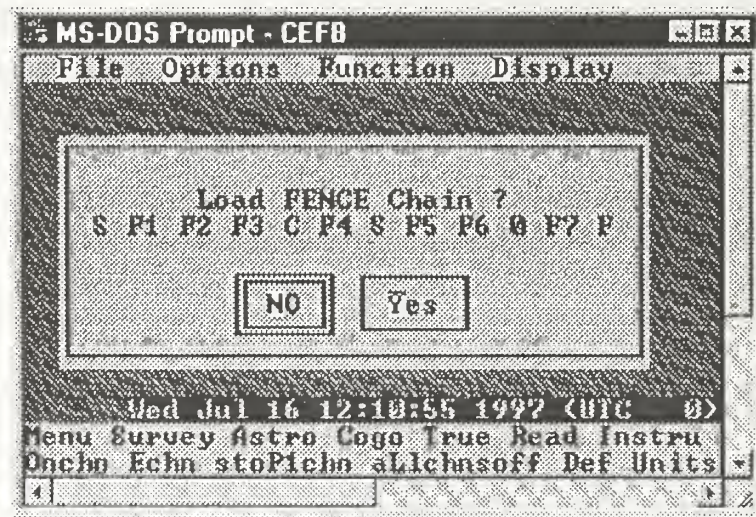


Figure 10.26: Load FENCE Chain

If the FENCE chain string shown in Figure 10.26 is selected to be loaded, the second FENCE chain string in the chain file in Figure 10.22 could not be loaded. This is because there is only one FENCE identifier in the index file, and it would have already been activated for chain collection. If the FENCE chain string in Figure 10.26 was not selected to be loaded, the 'Load chains' function would then prompt for loading of the second FENCE chain string as shown in Figure 10.27.

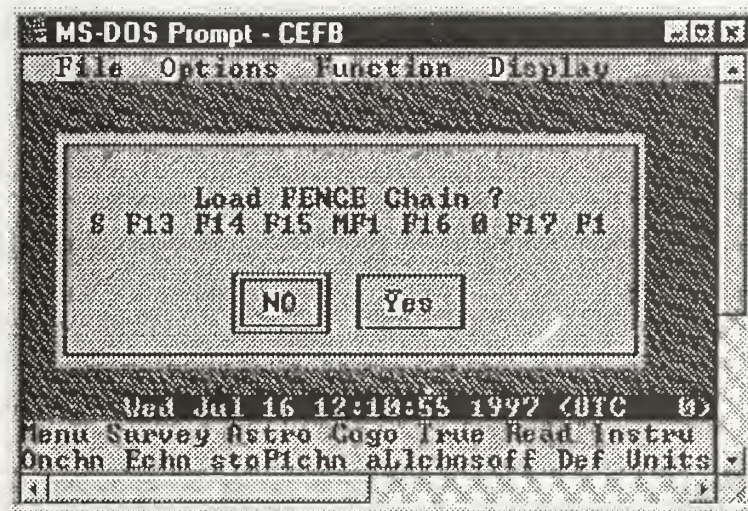


Figure 10.27: Load FENCE Chain

When the loading chain file equals the output chain file, those chain strings are deleted from that chain file. The chain strings are replaced in the chain file when the updated chain strings are written to the chain file from CEFB. When the chain file name being loaded does not match the chain file name being written to, the loaded chain file is maintained, however, the descriptions for the each loaded chain string are brought into to the chain file being written to.

CHAPTER ELEVEN - CEFB - Feature Codes

Overview

Descriptive feature codes have several syntaxes such as [], < >, and < ~ >, that handle several feature code operations and have become common place for CEFB surveyors.

Feature codes now perform three more operations to aid in field note automation. They now have the ability to 1) obtain inversed bearings and/or distances from the CEFB (.cr) coordinate file and placed into the descriptions; 2) format bearings as specified for field notes in the Manual of Surveying Instructions; 3) branch out into other feature codes to describe specific aspects of a feature; and 4) handle caps markings for public land survey system monuments.

Appendix G illustrates the syntax of feature codes as well as two examples of CEFB feature codes files detailing the branching scheme with the previously mentioned operations or syntaxes incorporated. The first example is a sample feature code file that could be utilized in the initial data collection for a boundary survey, where the second example is a feature code file geared towards the production of field notes. The philosophy behind the two feature code files is there are two stages of the descriptive collection in cadastral surveying: initial collection of what is found, and field note collection after boundary analysis.

Appendix G can provide a foundation for surveyors to develop their own customized system of feature codes. One should study the syntax of these files, and try executing some of the feature codes to help gain a better understanding of the functions discussed in this chapter.

The #B, #D, and #BD Functions

The ability to derive bearings and/or distances from inverting CEFB (.cr file) coordinates, and place them into feature codes is accomplished with the # symbol. The # symbol when immediately followed by a **B**, **D**, or **BD** will retrieve a bearing, a distance, or a bearing and distance respectively. The **B**, **D**, and **BD** characters must be in capital letters in order to execute those functions. Figure 11.1 displays the STONE_WALL feature code taken from Appendix III.

STONE_WALL [Along Corner End] of a stone wall in [good poor] condition, approximately <Width in Feet?> ft. wide, standing <Height in Feet?> ft. high, bears #B <ADD?~>

Figure 11.1: STONE_WALL Feature Code

Execution of #B in the STONE_WALL feature code in Figure 11.1 will prompt the surveyor for **From** and **To** stations to define the station ID's to produce the bearing and/or distance. Figure 11.2 displays the **From** prompt while Figure 11.3 displays the **To** prompt.

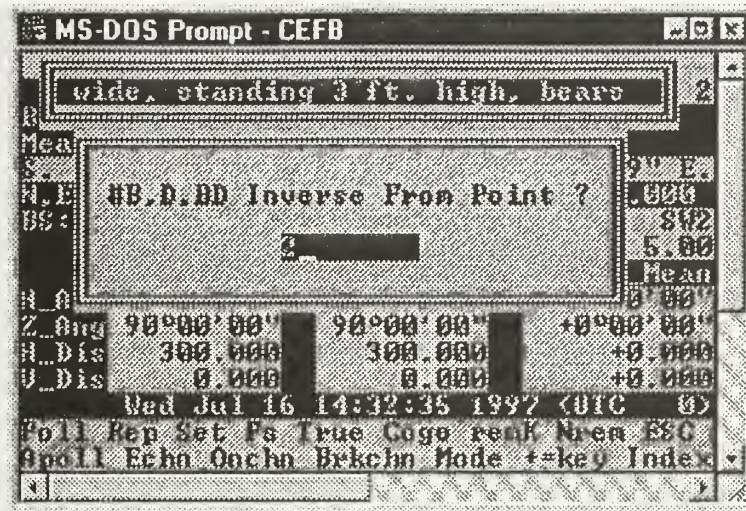


Figure 11.2: #B,D,BD From Prompt

The default station for the **From** prompt shown in Figure 11.2 is the OC station ID, while the default station for the **To** prompt shown in Figure 11.3 in the FS station ID.

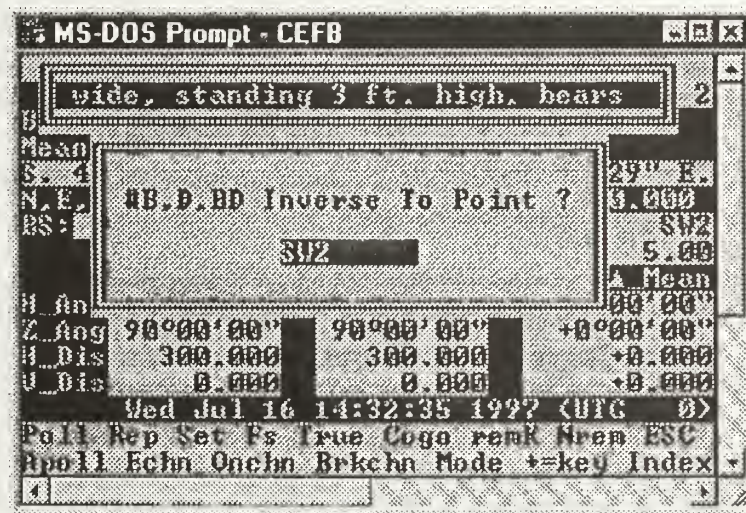


Figure 11.3: #B,D,BD To Prompt

For this example, let's say the **From** and **To** stations were defined as SW1 and SW2, respectively. If both of those stations ID's are in the CEFB (.cr) coordinate file the corresponding bearing would be brought into the description as shown in Figure 11.4.

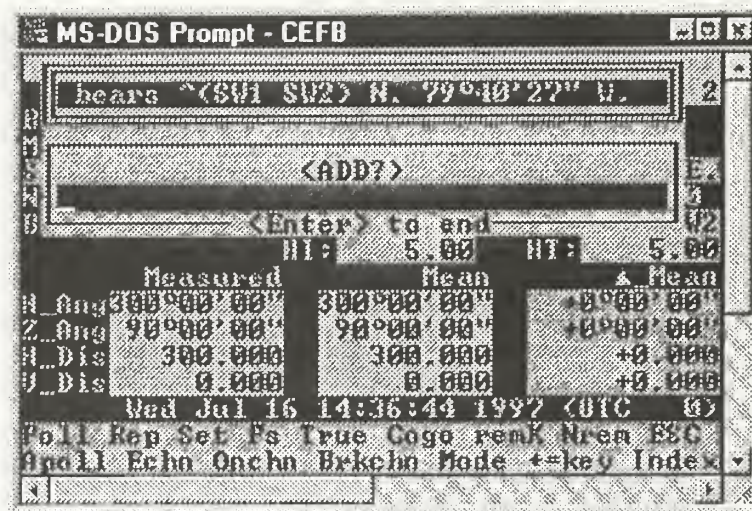


Figure 11.4: #B Result

You'll notice the ^ (SW1 SW2) before the bearing in the description in Figure 11.4. The current CEFB (.cr) coordinate file producing the bearing between station ID's SW1 and SW2 will usually not be final coordinates. Therefore bearings and/or distances in descriptions must be updated based on final coordinates in the production of final field notes. The ^ (From To) exist in the descriptions utilized in the #B, #D, #BD functions to facilitate the revision of those bearings and/or distances later in post processing by identifying the **From** and **To** station ID's.

The STONE_WALL feature code example only utilized the #B symbol. Figure 11.5 shows the result if the #BD symbol was utilized.

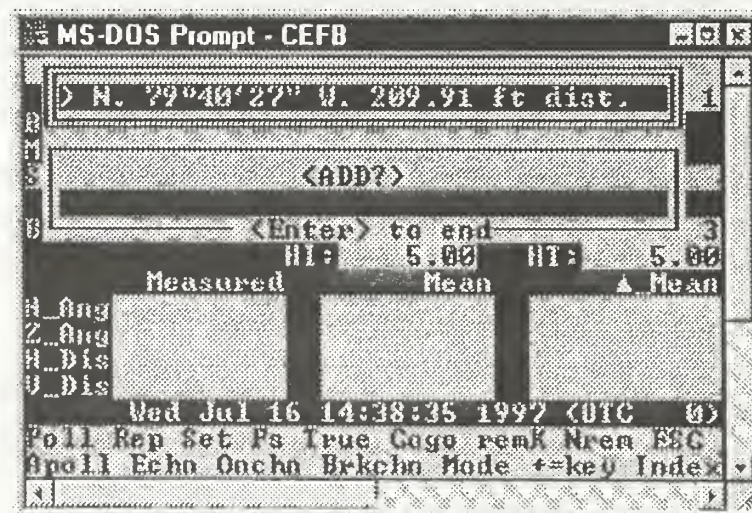


Figure 11.5: #BD Result

The results in Figure 11.5 illustrate the distance as it would appear in a set field of field notes with the **ft. dist.** following the distance. The same is true for the format of the bearing in Figure 11.5. The **ft. dist.** illustrates FEET as the horizontal unit. Figure 11.6 displays the results in the STONE_WALL feature code if CHAINS was the horizontal unit and #D was utilized.

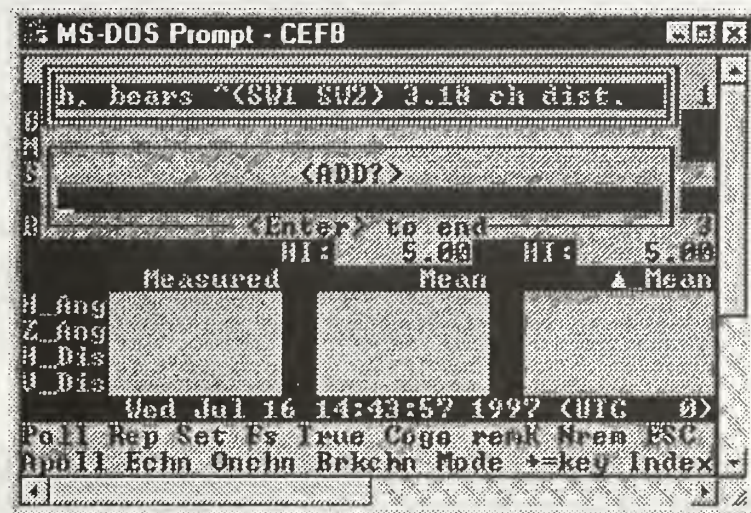


Figure 11.6: #D Result

If one or both of the stations ID's enter in the **From** and **To** prompts are not in the CEFB (.cr) coordinate file, the **#B**, **#D**, and **#BD** functions notifies the surveyor which points do not exist in the coordinate file, then prompts the surveyor to manually type in the respective bearing and/or distance. For example, let's use the STONE_WALL feature code with the **#BD** symbol, the same SW1 and SW2 station ID's, and let's assume SW1 is not in the coordinate file. Figure 11.7 displays the result from that assumption.

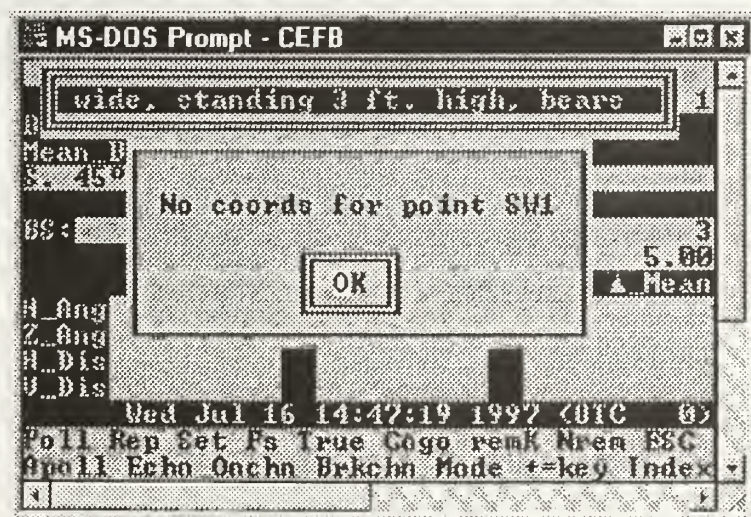


Figure 11.7: Station ID Not in Coordinate File

Figures 11.8 and 11.9 display the manual entry prompts for the bearing and distance respectively.



Figure 11.8: Manual Bearing Prompt

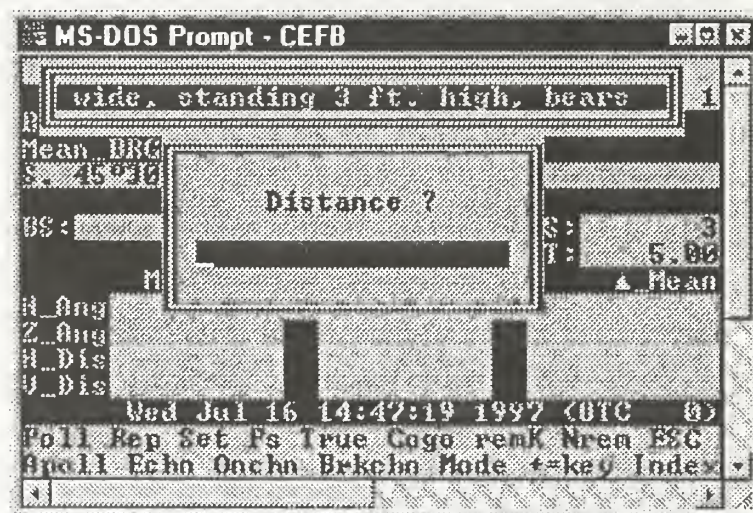


Figure 11.9: Manual Distance Prompt

Figure 11.10 displays the results from the manual entry of N. 45°24'30" W. and 100.0 for the bearing and distance. Note these values can be replaced in office processing of the descriptions as matched to final coordinates.

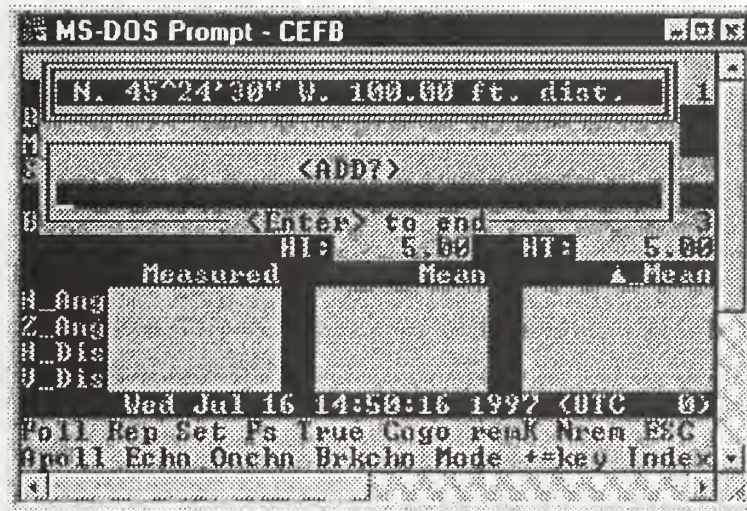


Figure 11.10: Manual Entry Results

The display of the building description has been moved up to the top row of CEFB. This is to eliminate any overlap between the feature code line and any pick lists or prompts incurred in the execution of the feature code. This enables the surveyor to view the entire feature code as it is being executed.

The Branching Scheme

There are many instances when describing certain situations where the surveyor might want to describe a certain aspect of an object one time, and not describe that aspect for another object at another time. An example of this would be describing a collar of stone for one monument while not describing a collar of stone for another monument. The ability to branch to other existing feature codes facilitates this process and minimizes the number of required feature codes. The following set of **MON_SET** feature codes will be utilized to demonstrate how feature codes handle this type of operation without the branching scheme implemented. The branching scheme will then be implemented into the **MON_SET** feature codes to illustrate the effectiveness of the branching scheme.

- MON_SETROD** Set an aluminum rod, 30 ins. long, 3/4 in. diam., <how deep? (ins.) > ins. in the ground, alongside a "DEEP-1", [in_a_collar_of_stone no_collar_of_stone], <diam. (ft.)> ft. diam, with an 2 in. aluminum cap mkd. as shown.
- MON_SETPOST** Set an [stainless_steel aluminum_post], 30 ins. long, 2 1/2 ins. diam., <how deep? (ins.)> ins. in the ground, over a "DEEP-1", [in_a_collar_of_stone no_collar_of_stone], <diam. (ft.)> ft. diam, with an aluminum cap mkd. as shown.
- MON_SETCAP** Seat a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, with concrete, flush with <surface ?~> with top mkd. as shown.

There are three separate feature codes to describe the typical types of monuments set in cadastral surveys, **ROD**, **POST**, and **CAP**. Execution of the **MON_SETPOST** feature code for the two scenarios (collar of stone/no collar of stone) produces the following result.

Collar of stone:

Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 27 ins. in the ground, over a "DEEP-1", in_a_collar_of_stone 2 ft. diam, with an aluminum cap mkd. as shown. T27N R26W S2|S3 1996

No collar of stone:

Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 27 ins. in the ground, over a "DEEP-1", no_collar_of_stone 0 ft. diam, with an aluminum cap mkd. as shown. T27N R26W S2|S3 1996

The No collar of stone feature code contains verbiage (no_collar_of_stone 0 ft. diam) that would not actually be desired in the production of field notes. For field note production to occur, feature codes must resemble the final notes as much as possible, and have the ability to manipulate this concept without placing unwanted wording in descriptions. This capability is achieved with the branching scheme. The basic concept behind the branching scheme is that surveyors have the ability to call another feature code from within a feature code. This can be called a branch out. Once another feature code has been called, control is released from the original feature code. Elaborate branches can be created to control a wide variety of descriptions.

There are two areas where feature codes can branch to another feature code. The first area is within the [] brackets. If a pick list has a choice identical to another feature code, and that choice is selected, that particular feature code will be executed.

The second area is in the standard text section of a feature code with the # symbol. If the # symbol is immediately followed by an identifier of an existing feature code, control is given to that feature code. Control cannot return to the original feature code. This method of branching would normally be utilized only at the end of a feature code.

The flexibility of the branching scheme is demonstrated below in the combination of the **MON_SETROD**, **MON_SETPOST**, and **MON_SETCAP** feature codes into one **MON_SET** feature code. Examples of the [] branching are shown below with the **Set**, **sectional_rod**, and **in_a_collar** feature codes, while the # symbol branching is shown below in the **AT** feature code.

AT At the corner point. #**MON_SET**

MON_SET [Seat Set] a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with [asphalt concrete ledge rock] with top mkd. as shown.

Set an [stainless_steel aluminum] [post sectional_rod], 30 ins. long, 2 ½ ins. diam., <DEEP (INS.)?> ins. in the ground, over a "DEEP-1", [in_a_collar with_an] [aluminum steel] cap mkd. as shown.

sectional_rod <LONG (INS.)?> ins. long, 5/8 in. diam., driven <DRIVEN (INS.)?> ins. in the ground, with a "DEEP-1" alongside, [in_a_collar with_an] [aluminum steel] cap mkd. as shown.

in_a_collar of stone, <HIGH (FT.)?> ft. high, <WIDE (FT.)?> ft. wide, with an [aluminum steel] cap mkd. as shown.

Execution of the **MON_SET** feature code handles descriptions for a post, sectional rod, and a brass tablet (three typical monuments for a cadastral survey) while eliminating unwanted verbiage shown in the (collar of stone/no collar of stone) example. Execution of the **MON_SET** feature will now produce the following result for the collar of stone scenario.

Collar of stone:

Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 27 ins. in the ground, over a "DEEP-1", in_a_collar_of_stone 2 ft. diam, with an aluminum cap mkd. as shown.

No collar of stone:

Set an aluminum post, 30 ins. long, 2 ½ ins. diam., 27 ins. in the ground, over a "DEEP-1", with_an aluminum cap mkd. as shown.

The **MON_SET** feature code could also produce **MON_SETROD** and **MON_SETCAP** descriptions:

Set stainless_steel sectional rod, 30 ins. long, 5/8 in. diam., driven 28 ins. in the ground, with a "DEEP-1" alongside, with_an steel cap mkd. as shown.

Seat a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with ledge with top mkd. as shown.

The # symbol is also utilized with the **B**, **D**, or **BD** functions. Therefore surveyors cannot define **B**, **D**, or **BD** identifiers in the feature code file and utilize them with the branching scheme. Surveyors must pay attention to what feature they are branching to when using the # symbol when designing feature code files. One would not want to branch to the same feature code that you are currently executing. This would create an infinite loop, which is not good.

The **Set**, **sectional_rod**, and **in_a_collar** feature code identifiers are combinations of upper and lower case characters while the **MON_SET** feature code identifier is completely in upper case. The branching scheme allows surveyors to combine several feature codes into one large feature code with several branches as demonstrated previously. Branches of a larger or original feature code will only be accessed when the surveyor is executing the original or larger feature code. The surveyor does not want to scroll through pick lists of branching feature codes. The surveyor can avoid this situation by making those secondary branches feature code identifiers as lower case. Only complete capital letter character feature code identifiers are displayed in the pick lists. This enables surveyors to specifically define what feature codes are displayed in the description pick list, and which will not be displayed as they are branch type only.

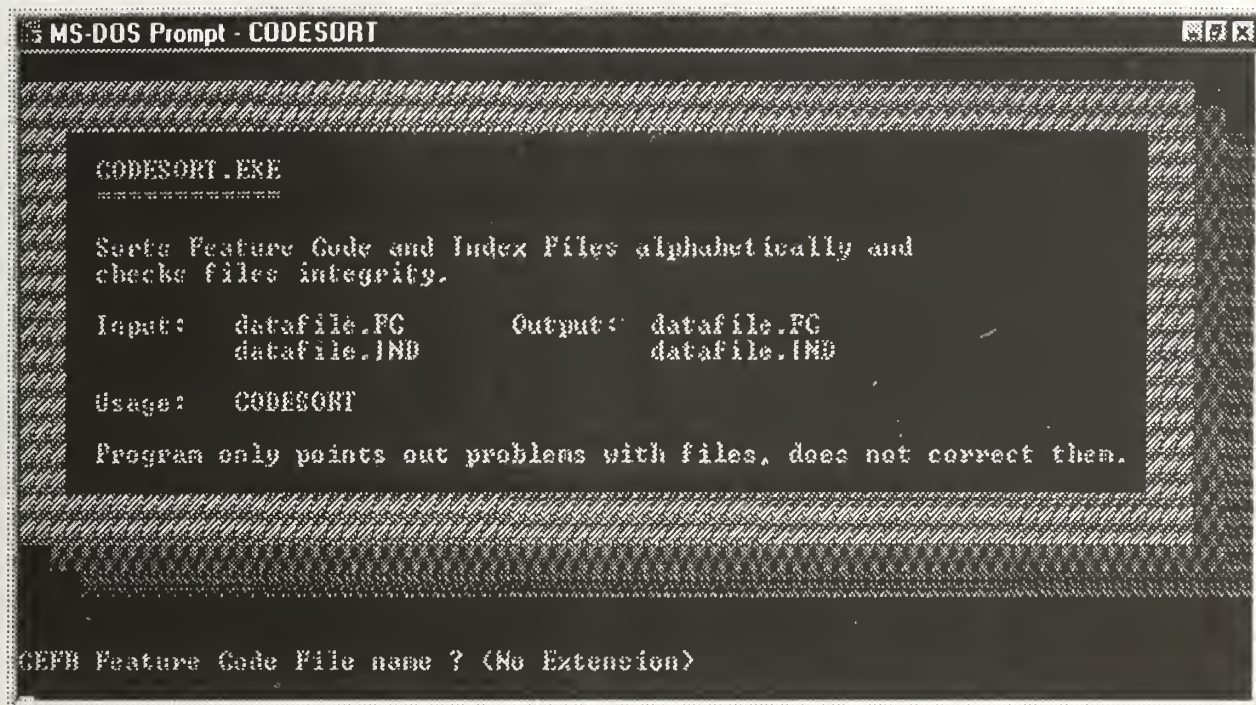
Cap Markings

Cap markings are an important component in field notes. Field notes clearly show the exact markings on the cap of each monument set or found in a cadastral survey. The Manual of Surveying Instructions defines the structure and format of several cap markings for the public land (rectangular) survey system. The CAP feature code and its corresponding branches shown in Appendix B define virtually every type of possible angle point and public land survey system cap marking down to the sixteenth corner level. The CAP feature code has a defined structure which is utilized in WordPerfect to automatically draw the cap markings. In more basic terms, once the CAP descriptions are brought into WordPerfect, a macro reads the CAP feature codes and automatically draws the lines of the cap markings and places the corresponding text. The five types of cap markings described by the CAP feature code are angle points, rectangular interior standard, rectangular interior subsection, rectangular interior meander, and rectangular exterior.

The new branching scheme and cap marking feature codes offers surveyors a great deal of flexibility to create an intricate system of feature codes. Surveyors must spend time defining the structure and type of remarks in the feature code file, and identifiers/prefixes in the index file. The capabilities of these files, and the amount of time they will save in data collection and the production of plats or field notes when effectively utilized, can be very demonstrative.

Codesort

It is extremely beneficial to sort identifiers in the index and feature code files alphabetically, as this enhances efficient selection from a pick list. Codesort is an extremely useful program to aid surveyors in alphabetical sorting and syntax validation of feature codes. Codesort now inspects the syntax and sorts features alphabetically in both index and feature code files. Codesort also now inserts the STA prefix with the TRAVERSE identifier if it does not already exist in the index file. This is to facilitate incrementation of integers or traverse station ID's. Figure 11.11 displays the initial screen of Codesort.



```
MS-DOS Prompt - CODESORT

CODESORT.EXE
Sorts Feature Code and Index Files alphabetically and
checks files integrity.

Input:  datafile.FC      Output:  datafile.FC
       datafile.IND     datafile.IND

Usage:  CODESORT

Program only points out problems with files, does not correct them.

CEFH Feature Code File name ? (No Extension)
```

Figure 11.11: Codesort Screen

Once the surveyor inputs the corresponding feature code and index files, the codesort program examines the format in a variety of ways. When an unacceptable format is found, a message detailing the problem and its line number is reported to the surveyor. All problems found in either file, are listed on the screen. The files are then sorted in alphabetic order. The fields that are inspected and the corresponding error messages are listed below.

Feature Code File

Unneeded hard return at the end of the Feature Code File ...

Incorrect # of fields in Feature Code File ...

Index file

Incorrect # of fields in Index File...

Prefix

Prefix in Index File contains integers ...

Prefix in Index file too long...

Identifiers

Identifier in Index File has no match in Feature code File...

Suffix

Counter in Index File is not an integer...

< > Prompt

< > Prompt too long in Feature Code File...

< > Bracket mismatch in Feature Code File...

[] Bracket

[] Bracket mismatch in Feature Code File...

Symbol

No match in Feature Code File after # sign...

Most of the error messages are self explanatory, however, a few need some explanation. The identifier message is not actually an error because it is not necessary to have matching identifiers in the index and feature code files. It is more a notification that automatic descriptions will not be available for that particular identifier in the index file. The screen size of CEFB limits the allowable length of the < > prompt to 34 characters. It is very important to remember that Codesort only points out problems with the files. Correction of these problems must be performed by the surveyor.

CHAPTER TWELVE - CSTUF - Field Note Production

Overview

The beginning, and most important, portion of field note production lies in the collection of descriptive and linework information in the field. The CSTUF Coordinate Geometry program in CMM provides the post processing tools for organization and manipulation of the descriptive and linework information into a formatted field note file ready for importation into the word processing software (WordPerfect).

There are two files needed to create a formatted field note file. The first file is a CEFB or generic chain file of the boundary which is to be described. The second file needed is a remark (.rem) file containing the desired remarks or descriptions of all angle and on-line points for the boundary. The first portion of this chapter will discuss the creation of the remark (.rem) file. Appendix D consists of two observation (.obs) files containing descriptions for three angle points in the boundary to be described.

Organization of Remark (.rem) File

Descriptions in the remark (.rem) file are arranged in two ways. They are grouped based on station ID's, and they are sorted in a particular order for a given station. For example, the descriptions for **400500** are all grouped under the **400500** station ID. Descriptions within the **400500** station ID are sorted based on the order specified in the REM.ORD file.

REM.ORD File

The REM.ORD file is an ASCII file defined by the surveyor listing the desired order of descriptions based on feature code identifiers. For example, the field note producing feature code file in Appendix G consist of the following capitalized feature code identifiers: POINT_FOR, MON_FD, FROM_WHICH_FD, AT, MON_SET, FROM_WHICH, TREE, BURY, THIS_COR., FROM_THIS, and CAP. These are feature codes which describe characteristics of a angle point in a set of field notes. These characteristics are usually described in a defined order or structure. For instance, corner descriptions in field notes usually follow this general order: a general description of the corner to be described; monuments or accessories found; monuments set; cap markings; accessories set; objects buried alongside; this corner is located verbiage; and from this cor. verbiage. Based on this general order, Figure 12.1 displays a REM.ORD file utilizing the feature code identifiers available.

```

THE
THIS_COR._POSITION
POINT_FOR
MON_FD_CON
MON_FD_PIPE
MON_FD_STONE
MON_FD_WOOD
FROM_WHICH_FD
## 4trees
## 3trees
## 2trees
## 1tree
AT
MON_SET
CAP
FROM_WHICH
## 4-trees
## 3-trees
## 2-trees
## 1-tree
FROM_THIS
THIS_COR.
BURY

```

Figure 12.1: REM.ORD File

Another standard format of field notes is the indentation of accessory descriptions. Surveyors can specify the indentation of particular feature codes with the use of the # character in the REM.ORD file. For instance, the # key in front of the TREE feature code in Figure 12.1 will automatically indent that description in the formatted field note file.

The branching scheme in feature codes allows “smaller” feature codes to be nested in a large feature code. An example of this are the tree descriptions nested in the FROM_WHICH feature code. Two # characters in front of a feature code identifier in the REM.ORD file will clip that smaller description out from the last feature code and indent it in the formatted field note file. For example, the FROM_WHICH identifier is followed by the 4trees, 3trees, 2trees, tree, and object identifiers in Figure 12.1. This indicates the identifiers with the ## characters in front of them are searched for, and clipped out of, the FROM_WHICH description, and indented in the formatted field note file. Below is a scaled down example of the FROM_WHICH description to illustrate this concept.

FROM WHICH: From which the new bearing trees **4** trees A maple, 10 ins. diam., bears N. 44°56' E. 8.8 ft. dist. **3** trees A hickory, 20 ins. diam., bears S. 54°52' E. 62.4 ft. dist. **2** trees A cedar, 15 ins. diam., bears S. 24°56'16" W. 30.8 ft. dist. **tree** A oak, 25 ins. diam., bears N. 14°52' W. 20.4 ft. dist.

The above description contains four smaller descriptions with their identifiers shown in bold. The resulting formatted field note file is shown below.

From which the new bearing trees

A maple, 10 ins. diam., bears N. 44°56' E. 8.8 ft. dist.

A hickory, 20 ins. diam., bears S. 54°52' E. 62.4 ft. dist.

A cedar, 15 ins. diam., bears S. 24°56'16" W. 30.8 ft. dist.

A oak, 25 ins. diam., bears N. 14°52' W. 20.4 ft. dist.

CSTUF Main Screen

The main screen of CSTUF now displays all available functions and their corresponding keystrokes as shown in Figure 12.2. Surveyors will no longer have to remember the keystrokes needed for the several different LOG functions.

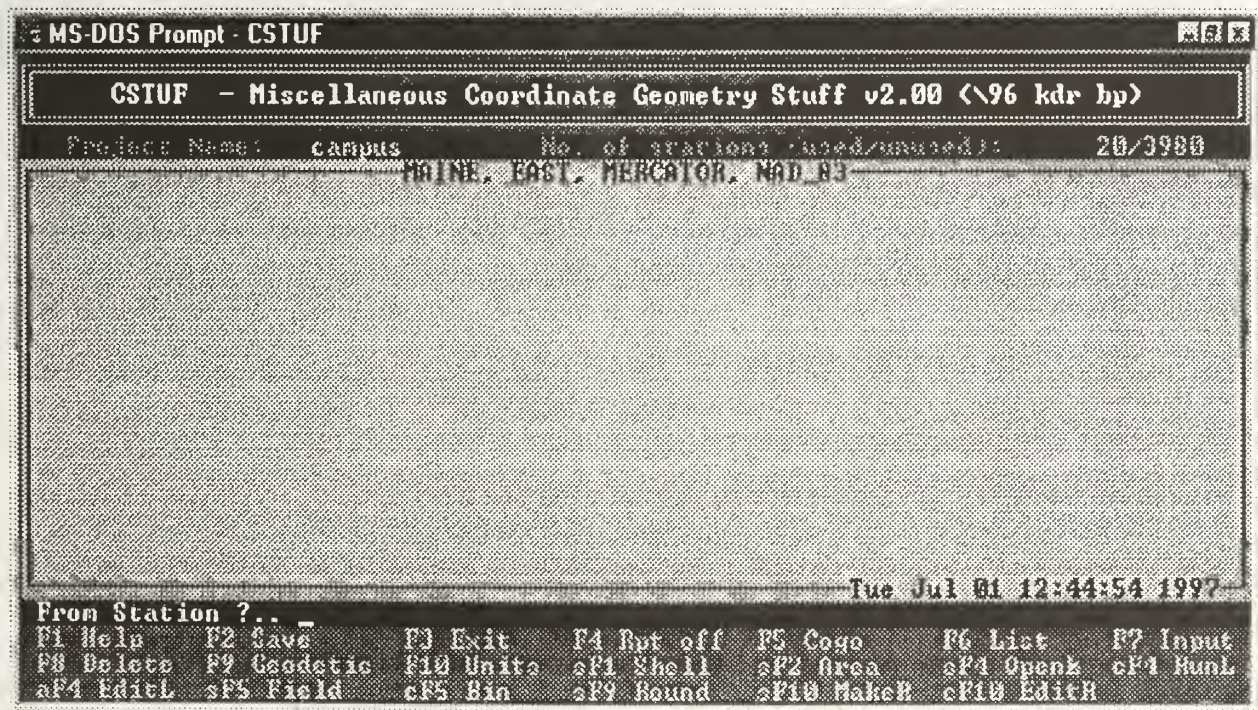


Figure 12.2: CSTUF Main Screen

Round(ing)

The rounding of bearings and distances varies in field notes. The 'Round' function in CSTUF enables surveyors to define the rounding elements for bearings and distances written to the screen or files. The bearing prompt of the 'Round' function is shown in Figure 12.3., while the distance prompt is shown in Figure 12.4.

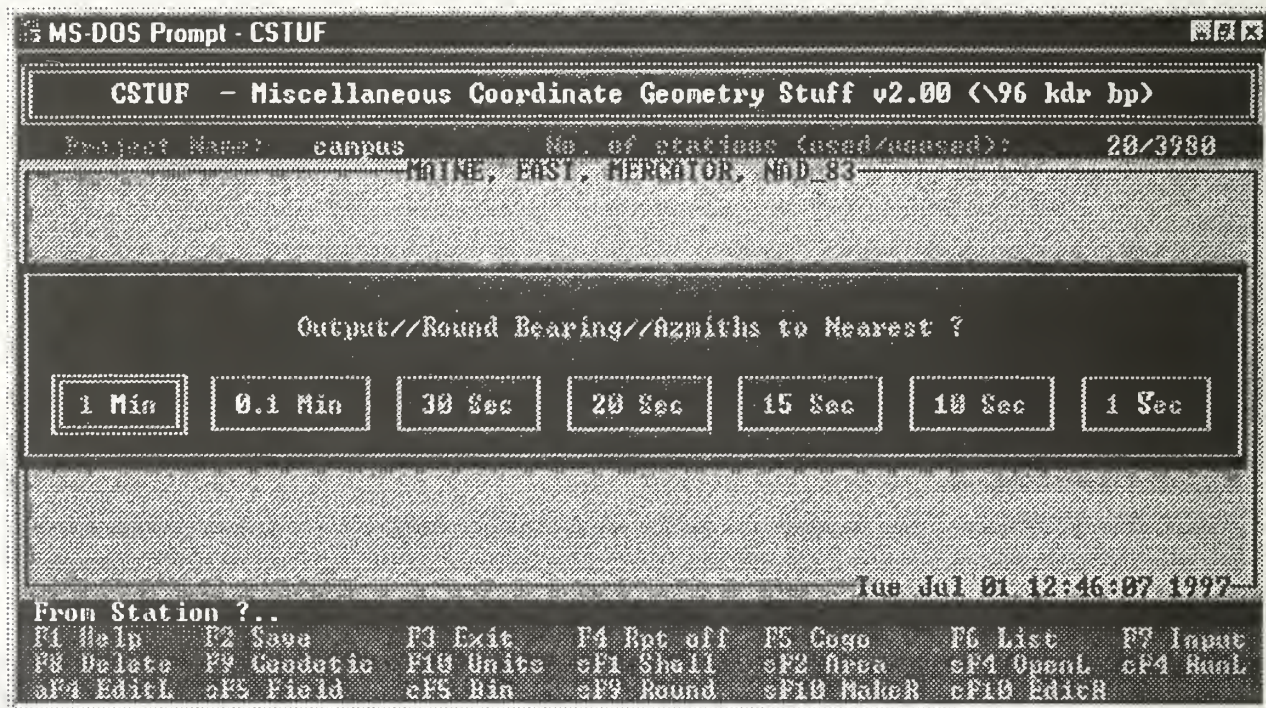


Figure 12.3: 'Round' Function - Bearing Prompt

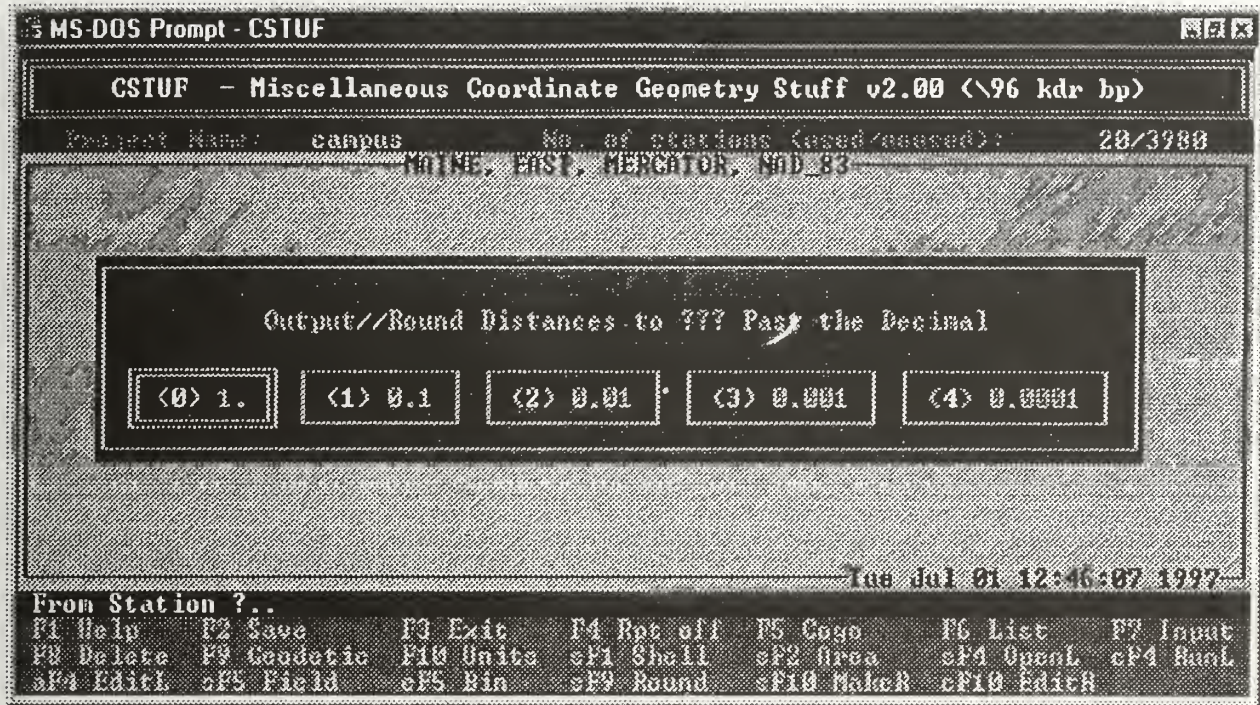


Figure 12.4: 'Round' Function - Distance Prompt

The 'Round' function is also executed during the 'MakeRem' and 'Field' functions. Both of these functions produce bearings and distances where rounding is pre-defined.

MakeR(em)

The 'MakeRem' function takes the descriptions from the defined observation file and groups them by station ID. It then sorts the descriptions for each station ID based on the REM.ORD file previously discussed. The 'MakeRem' function also updates the bearings and/or distances in the descriptions with the use of the **^(FROM TO)** verbiage as discussed in Chapter Eleven. The surveyor defines the observation (.obs) file which contains the descriptions with the prompt shown in Figure 12.5.

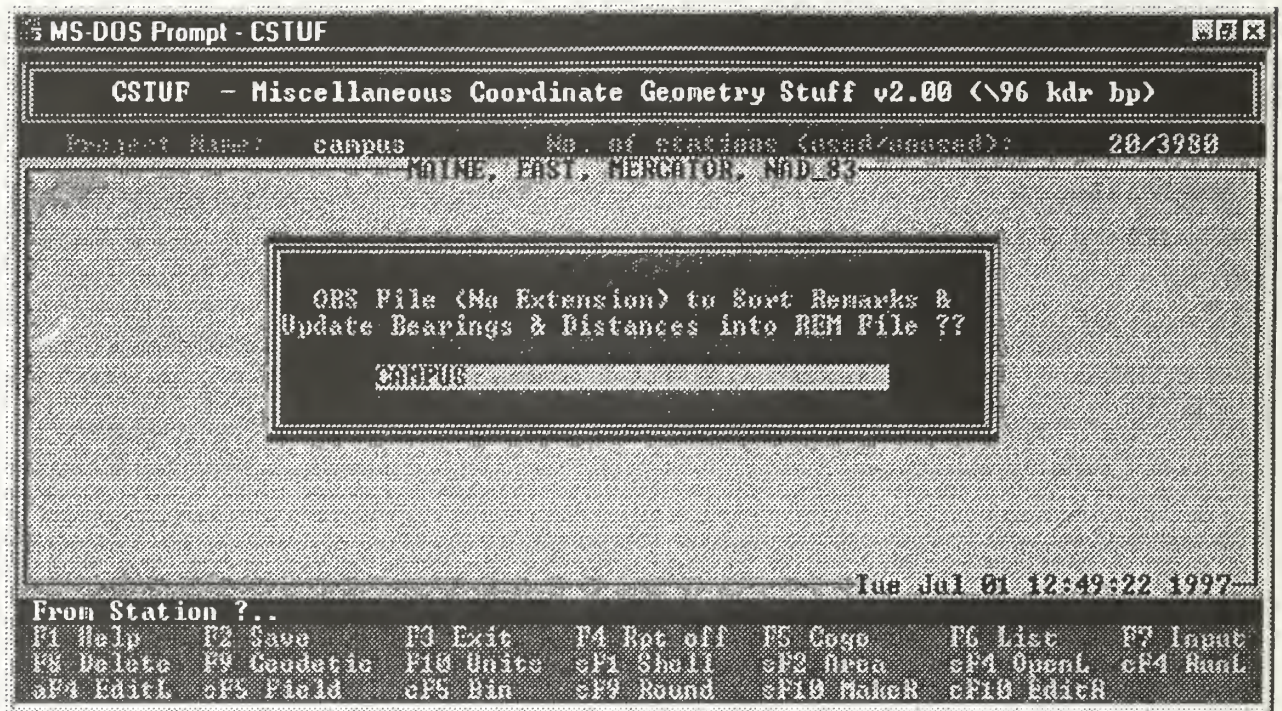


Figure 12.5: 'MakeRem' Function - Observation File Prompt

The operator is then prompted to define the linear and vertical units, and the rounding parameters for updating the bearings and distances in the defined observation (.obs) file. Once CSTUF begins processing the descriptions found in the observation file, station ID's found in the ^**(FROM TO)** verbiage not actually in the coordinate file, cannot update the bearing and/or distance for that description. The operator is notified for this occurrence with the message shown in Figure 12.6.

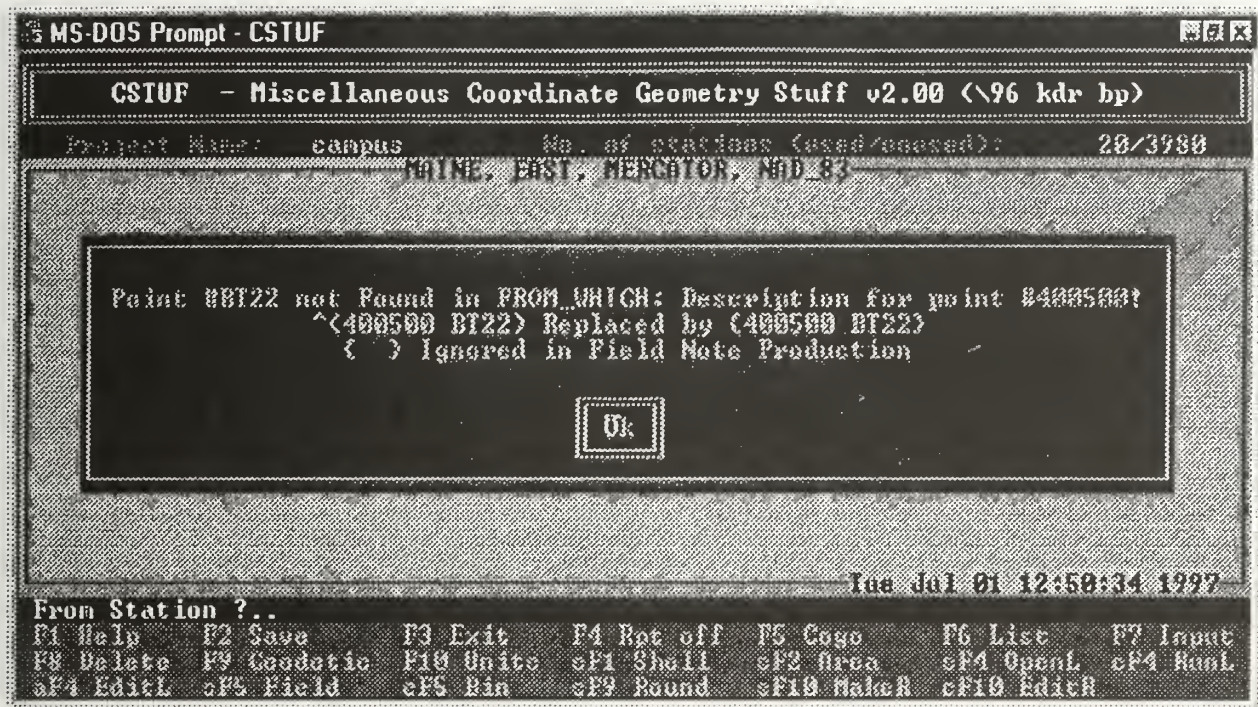


Figure 12.6: 'MakeRem' Function - Station ID Not Found

As Figure 12.6 states, the ^(<400500 BT22) is replaced by {400500 BT22} in the FROM WHICH description for point 400500. This implies the bearing and/or distance cannot be updated, and the FROM and TO station ID's are left in the description with the {} brackets to notify the surveyor. This allows the surveyor to change the station ID's to the actual bearing and/or distance using a text editor or word processor.

There would generally be several observation files which result in a complete set of field notes. Descriptions or remarks read from the defined observation file are correctly positioned into an existing remark (.rem) file. For example, both observation files in the Appendix D contain descriptions for the 540400 station ID. The remark file would contain descriptions for 500400 and 540400 once the 'MakeRem' function was performed on the first observation file. Execution of the 'MakeRem' function on the second observation file would take the descriptions for 540400 and correctly position them into the existing remark (.rem) file. Appendix E show the results of the 'MakeRem' function operated on the two observation files in Appendix D.

EditR(em)

The ability to edit descriptions at different stages in the process gives the surveyor the flexibility to execute those functions when one desires. The 'EditRem' function enables surveyors to view and/or edit descriptions in the remark file. The 'EditRem' function displays a pick list of available station ID's in the job remark file as shown in Figure 12.7.

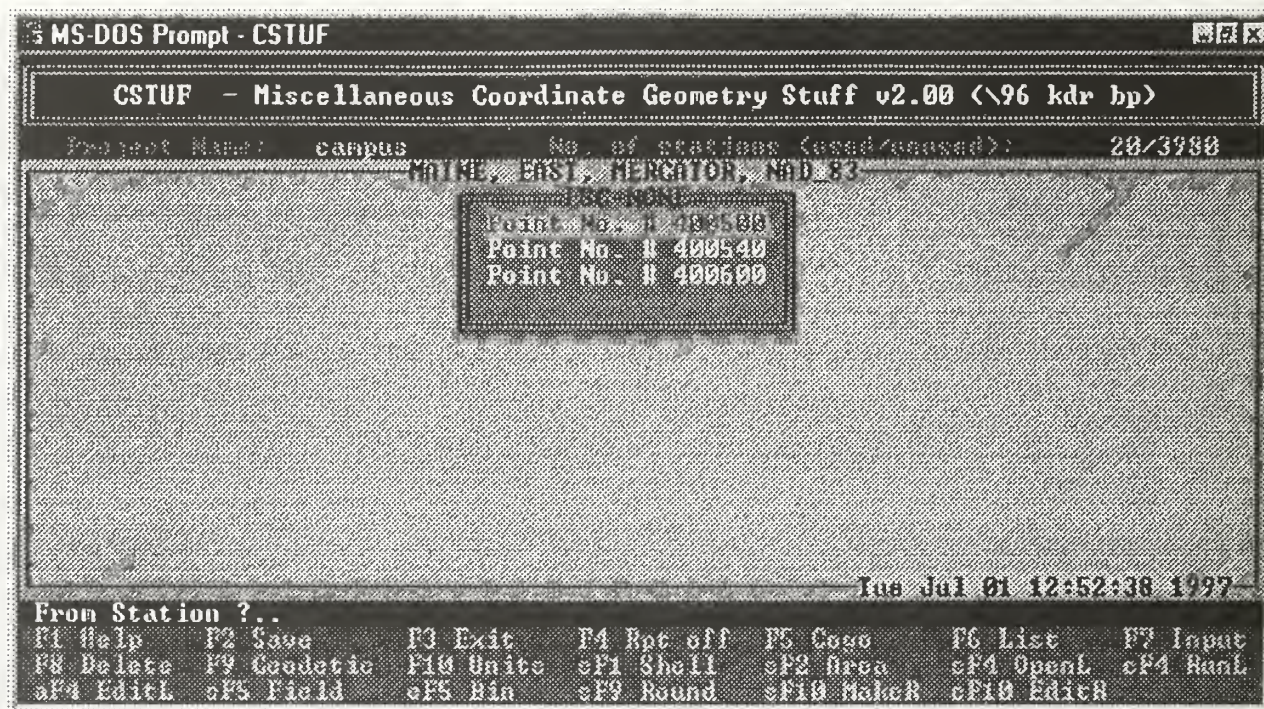


Figure 12.7: 'EditRem' Function - Station Pick list

Once a station is selected, the 'EditRem' function works in a similar fashion as the 'Shell' function discussed in Chapter Three for CEFB. The 'EditRem' function shells out of CSTUF into DOS and looks for a EDIT.DEF file. The surveyor uses the EDIT.DEF to define the desired editor he or she wishes to use to edit the descriptions for the selected station ID. Control is brought back to the main screen of CSTUF once the surveyor exits the defined editor. Descriptions are only updated when the surveyor saves those changes in the selected editor.

It is important to remember the remark file does not have to be edited with the 'EditRem' function. Any editor can be used at anytime to edit or observe the remark file.

Field (Notes)

The surveyor now has a complete remark file consisting of sorted and grouped descriptions, and a chain file depicting the boundary which needs to be described. The 'Field' function builds or appends a field note (.fn) file from the connectivity between the remark and chain files. The first prompt of the 'Field' function is shown in Figure 12.8.

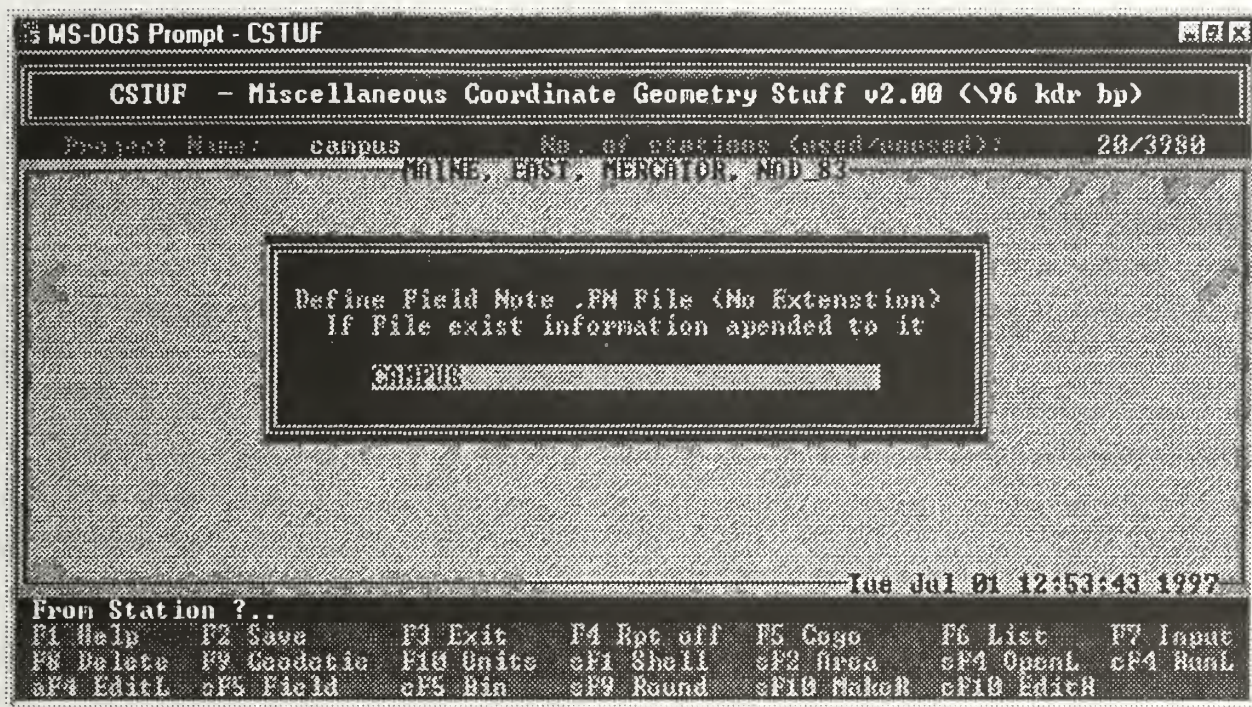


Figure 12.8: 'Field' Function - Field Note File Prompt

After the surveyor defines the units and rounding for the bearings and distances for the courses between points he or she must then define the chain file. This prompt is shown in Figure 12.9.

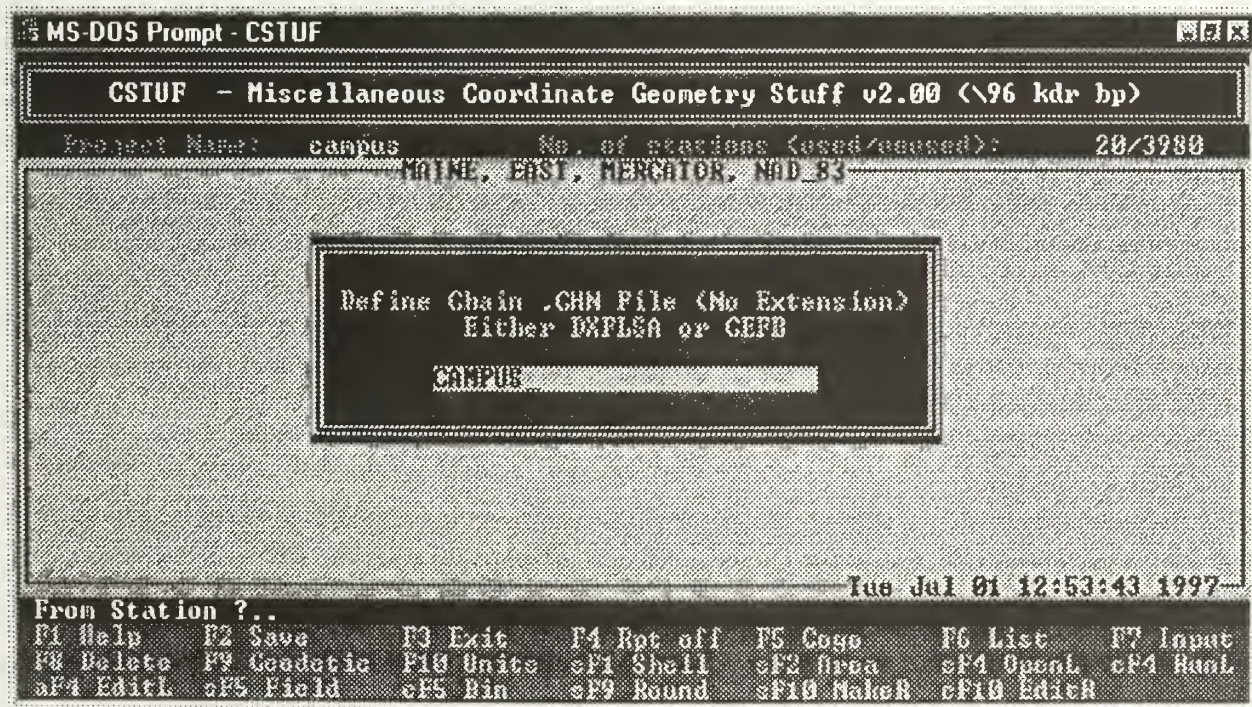


Figure 12.9: 'Field' Function - Chain File Prompt

The 'Field' function then creates or appends the defined field (.fn) file by merging the descriptions with the courses between the points in the chain file. Points in the chain file which do not have descriptions in the remark file are formatted as meander inverses in field note production. For this example, assume the chain file specified contains the following stations: 400500, 400540, 400600, 0, W1, W2, W3 W4, and W5 in that respective order. The resulting field (.fn) file is in Appendix F.

The Geographic Coordinate Data Base (GCDB) numbering system is used throughout CMM for the identification of standard township corners. Field notes describing standard township sections lines define the section lines they are describing in the THENCE, BEARING verbiage. For example, station ID's **400500**, **400540**, and **400600** utilized in the example in Appendices D, E, and F describe the line between sections 9 and 10. If GCDB ID's are utilized in the remark (.rem) and Chain (.chn) files, the 'Field' function has the intelligence to place the corresponding verbiage in the bearing description. Appendix F illustrates this in the bearings verbiage between points **400500-400540** and **400540-400600**.

Field notes usually have occurrences when there can be several monuments or topography described with no break in bearing (on the same line). This occurrence is handled with down line distances from the first point to the break in bearing. The 'Field' function examines the break in bearing between the current and last bearing and determines if the bearing verbiage should be inserted into the field note (.fn) file. If the software determines there is no break in bearing, instead down line distances are provided between points. Breaks in bearing are, however, always inserted at section corners with the use of GCDB ID's.

CHAPTER THIRTEEN - Plat Production with DXF

Linework and symbology of points are important characteristics when producing plats for any survey. The ability to create an DXF (.dxf) file for AUTOCAD with linework and symbology can greatly decrease the time required in producing a final plat.

The DXF program in CMM creates the link between CMM and AUTOCAD by producing a DXF file to import into AUTOCAD. The DXF program now has the ability to read CEFB produced chain (.chn) files. The DXF program can now also read CEFB observation (.obs) files to facilitate the symbology of points. This works by matching the identifiers of descriptions or remarks for points in the observation file with a DXF file, created with the DXFOUT command in AUTOCAD, containing blocks of the same name. For instance, if the observation file defined has a description for T1 with the TREE identifier, and the surveyor has a TREE block (symbol), that block will be placed at T1's position. The observation and chain files in Appendix C will be utilized for this discussion. The option menu of the DXF program is shown in Figure 13.1.

COMPUTER PROGRAM DXF CMM VER. 1.3 09-05-96

THIS PROGRAM ALLOWS HITTING ENTER TO ACCEPT WHAT IS IN < > OR
YOU CAN INPUT AS NORMAL.

IT ALSO ALLOWS ENTRY OF CHAINS FROM THE KEYBOARD WHICH WILL ALSO BE STORED
IN A FILE

DXF OPTION MENU (ZERO SIZE MEANS NONE)

- (1) ONLY STATIONS ON CHAINS OR FEATURE CODED BROUGHT TO GRAPHICS
- (2) COORDINATES READ FROM ADJUSTED .COR FILE
- (3) LINES & FEATURE CODES READ FROM CEFB CHAIN AND .OBS FILE
- (4) STATION NAME TEXT HEIGHT IS 10.0
- (5) UNKNOWN CORNER SYMBOL RADIUS IS 0.0
- (6) CONTROL SYMBOL SIZE IS 0.0
- (7) RECORD DATA HEIGHT IS 0.0
- (8) ELEVATION TEXT HEIGHT IS .0 ROUNDED TO 2 PLACES PAST DECIMAL
- (9) NO ERROR ELLIPSES WILL BE DRAWN

PICK A # TO EDIT, PRESS ENTER TO QUIT MENU SELECTION
DO YOU WANT

Figure 13.1: DXF Program Option Menu

There are nine different settings in the option menu surveyors can select to modify the format of the DXF file. The first setting defines whether all stations, or only feature coded and chain stations, are brought to graphics. The second setting defines whether coordinates are to be read from the adjusted coordinate .COR file or the input measurement .LSA file. The third setting defines the linework and or symbology desired by the surveyor. Figure 13.2 displays the menu prompted for the third setting. The remaining settings in the options menu deal with text size for a number of data types and are self-explanatory.

```

(1) LINES DRAWN FROM .LSA FILE
(2) LINES DRAWN FROM GENERIC CHAIN FILE
(3) LINES DRAWN FROM CEFB CHAIN FILE AND FEATURE CODES FROM OBS
(4) NO LINES DRAWN
PICK A # <1>

```

Figure 13.2: DXF Program Linework Menu

The third selection in the menu shown in Figure 13.2 enables surveyors to draw lines from CEFB chain files and symbology from feature code identifiers from a observation (.obs) file. With this default set, execution of the program prompts surveyors to define DXF filenames containing blocks for point symbology. This prompt is shown in Figure 13.3.

```

                PROJECT IS RAY
INPUT DXF FILE NAME (NO EXTENSION) CONTAINING BLOCKS FOR POINT SYMBOLOGY
PRESS ENTER IF NONE OR FINISHED WITH BLOCK ENTRY

    14 BLOCKS HAVE BEEN READ IN

INPUT DXF FILE NAME (NO EXTENSION) CONTAINING BLOCKS FOR POINT SYMBOLOGY
PRESS ENTER IF NONE OR FINISHED WITH BLOCK ENTRY

```

Figure 13.3: DXF Program DXF File Prompt

When these files are correctly loaded and their scale defined, the DXF program then prompts the surveyor to define the chain and observation file(s) desired for drawing linework. These prompts are shown in Figure 13.4. The default files for these prompts are the job name with the corresponding (.chn) extension.

```

NOW LOADING RAY.CHN
INPUT CEFB CHAIN FILE NAME (NO EXTENSION, .CHN ASSUMED)
PRESS ENTER TO QUIT CHAIN FILE INPUT

INPUT SCALE FOR BLOCKS <1.00>

NOW LOADING RAY.OBS
PIPE                FEATURE CODE HAS NO BLOCK FOR IT - IGNORED

INPUT CEFB .OBS FILE NAME (NO EXTENSION, .OBS ASSUMED)
PRESS ENTER TO QUIT CHAIN FILE INPUT
Stop - Program terminated

```

Figure 13.4: DXF Program Chain File Prompt

The DXF program then produces a DXF file containing linework from the chain file(s) specified and reports to the screen the points found in the job name observation (.OBS) file with feature code identifiers matching the DXF blocks read. The DXFIN function in AUTOCAD transports the data from the produced DXF file into AUTOCAD. Figure 13.5 displays the resulting AUTOCAD drawing from a DXF file utilizing the observation and chain files in Appendix C. Note all data is layered by feature code.

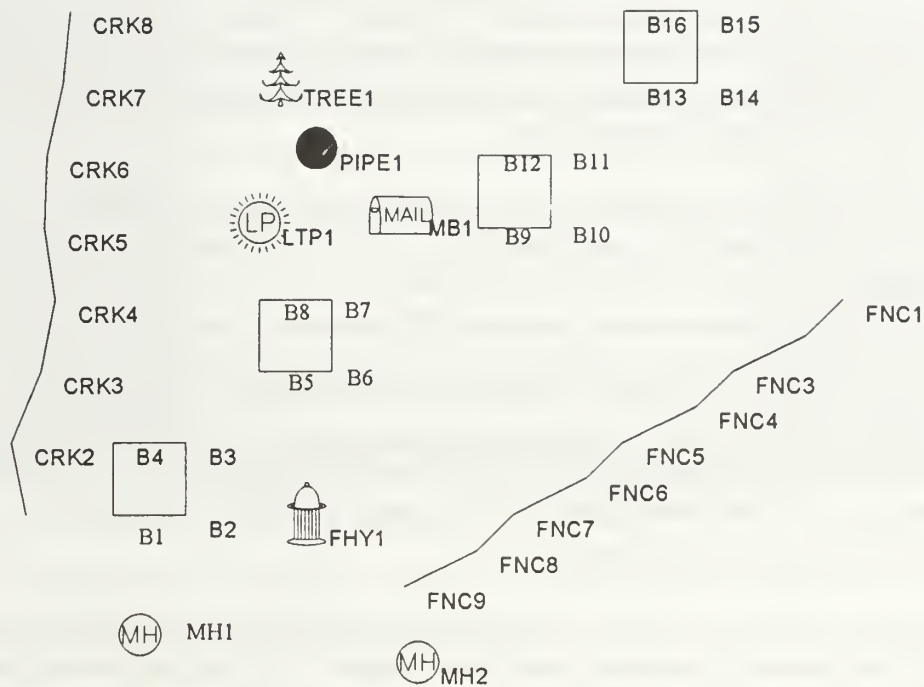


Figure 13.5: AUTOCAD Drawing DXF Program Results

This chapter illustrates the connection between the collection of descriptions and linework in the field, and its depiction in a drafting environment. This process can be used for quick effective plat production of chain and point symbology data.

CHAPTER FOURTEEN - WordPerfect - Field Note Production

Overview

The final step in the field note production process is creating a document formatted as specified by the Manual of Surveying Instructions by utilizing the field note file created in CSTUF. The Bureau of Land Management has chosen WordPerfect version 6.1 as the software platform for their word processing responsibilities.

There are three sets of files that must be installed into the WordPerfect directories to utilize the macros developed for field note formatting. The *.INF files provide standard information for several Field Note macros. They must be placed in the C: drive in a directory named FN_INFO. The *.inf files will be discussed in the SETUP macro. The *.WPT (template) files are initial standard forms for different categories of documents. For example, there are four developed templates placed in the TEMPLATE directory of WordPerfect. They are Plat Transmittal, Corner Recordation, Feet Field Notes, and Chains Field Notes. WordPerfect allows grouping of these templates for easy identification. The *.WCM (macros) files provide all of the functions necessary for effective formatting of field notes and other documents, and are placed in the MACRO directory of WordPerfect.

Templates are used when creating a new document. Templates contain all formatting and screen settings, and provide a consistent "look" to documents. Prompts can be built into templates which are then pasted into specified locations in the new document. Macros perform particular formatting functions inside a document. The four templates will be discussed followed by the field note formatting macros.

Plat Transmittal Template

Templates are initiated from the NEW function in the FILE pull-down menu. The plat transmittal template prompts for the information shown in Figure 14.1.

Template Information

Group No.:		OK
State:		Cancel
Define Plat:		Next Field
Define Survey:		
Surveyor:		Personal Info...
Beginning Date:		Help
Completed Date:		
Special Instructions Date:		
Attachement Plats:		

Figure 14.1: Plat Transmittal Template Information

The Plat Transmittal template is shown below. The information shown in Figure 14.1 is inserted or pasted into the template at its corresponding ☐ location.

9650(942)
Group No.[Group No.]
[State]

Memorandum

To: Deputy State Director for Cadastral Survey

From: Chief, Branch of Cadastral Office Operations

Subject: Transmittal of Plat, [Define Plat]

Enclosed for examination and acceptance are the final returns of the

The survey was made at the request of [Define Survey]

Survey executed by [Surveyor], Cadastral Surveyor, beginning [Beginning Date] and completed [Completed Date], pursuant to Special Instruction dated [Special Instructions Date] for Group No. [Group No.], [State]

The plat will be immediately placed in the open files and will be available to the public as a matter of information. Copies of the plat may be furnished to the public upon payment of the appropriate fee. Public notice as provided in 43 CFR 1813.1-2 is required. The date of the official filing shall be promptly reported on form 1810-6 which will be placed in the official group file. The date selected for the filing shall be at least 45 days after the date, the Federal Register noticed is signed.

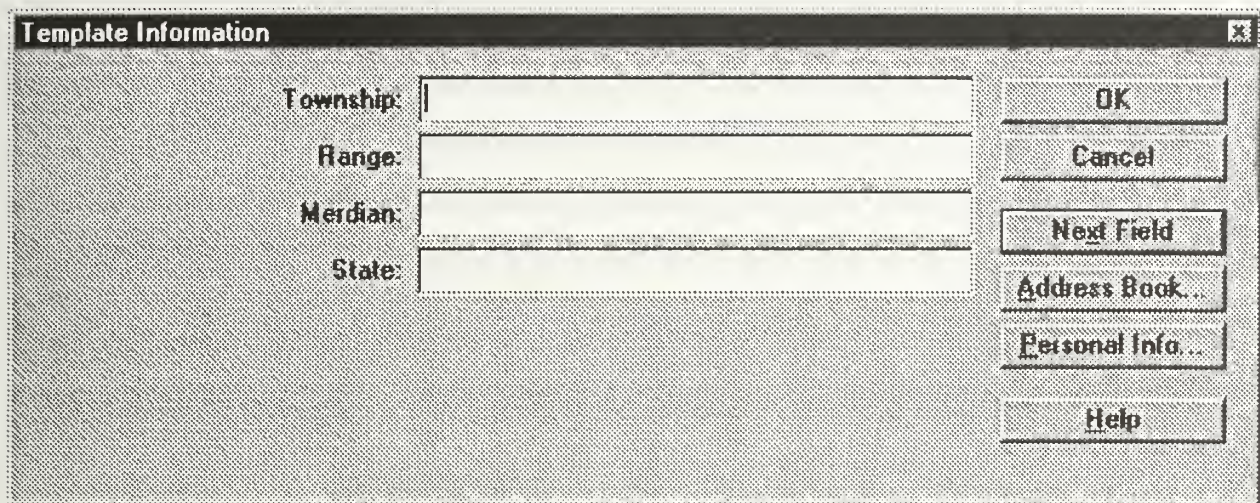
Accepted _____
For the Director

Chief Cadastral Surveyor
Eastern States Office

Attachment
1-Original Plat [Attachment Plats] in Duplicate
1-Set Field Notes in Duplicate

Corner Recordation Template

More and more BLM state offices are using the corner recordation format for descriptions of corners for county courthouse recording purposes. The corner recordation template is very similar to the Plat Transmittal template. It prompts for the information shown in Figure 14.2.



The screenshot shows a window titled "Template Information". Inside the window, on the left side, there are four labels with corresponding text input fields: "Township:", "Range:", "Meridian:", and "State:". To the right of these input fields, there is a vertical stack of five buttons: "OK", "Cancel", "Next Field", "Address Book...", and "Personal Info...". At the bottom right of the window, there is a "Help" button. The window has a standard Windows-style title bar with a close button in the top right corner.

Figure 14.2: Corner Recordation Template Information

The Corner Recordation template is shown in Figure 14.3.

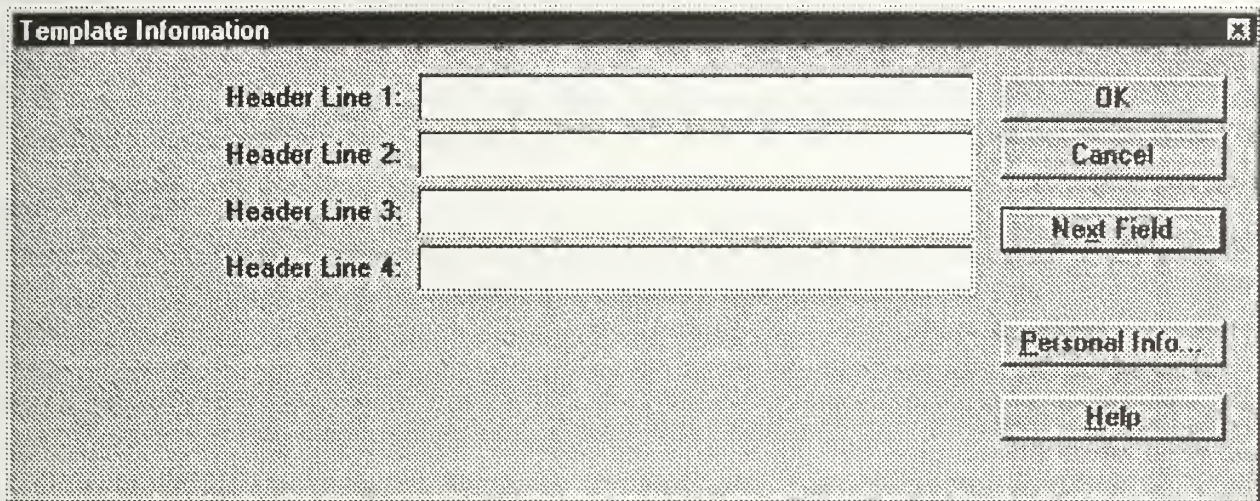
TOWNSHIP [TOWNSHIP], RANGE [RANGE]
[MERIDIAN] MERIDIAN, IN THE STATE OF [STATE]



Figure 14.3: Corner Recordation Template

Chains and Feet Templates

The only difference between the chains and feet template is the desired CHAINS or FEET in the distance column. These two templates prompt only for header information as shown in Figure 14.4.



The image shows a software dialog box titled "Template Information". It features four text input fields on the left, each preceded by a label: "Header Line 1:", "Header Line 2:", "Header Line 3:", and "Header Line 4:". To the right of these fields is a vertical column of five buttons: "OK", "Cancel", "Next Field", "Personal Info...", and "Help". The dialog box has a standard Windows-style title bar and a small icon in the top right corner.

Figure 14.4: Chains and Feet Template Header Information

The FEET template is shown in Figure 14.5.

[HEADER LINE 1]
[HEADER LINE 2]
[HEADER LINE 3]
[HEADER LINE 4]

<i>FEET</i>	

Figure 14.5: FEET Template

Field Note Tool Bar

Documents are created with the four described templates utilizing the developed field note tool and menu bar. The field note Tool Bar permits mouse driven execution of all available field note macros. Basic document operations are usually found in the Tool Bar. With the use of the field note Tool Bar, common functions usually found in the Tool Bar can be installed into the Power Bar. This can be accomplished with the preferences function in the Edit pull-down menu. The NOTES pull-down menu in the field note menu bar also contains all available field note macros. The macros discussed below are in the order that a surveyor would utilize them for efficient production of cadastral survey field notes.

SETUP

There are several characteristics of a cadastral survey that appear throughout a set of field notes. The setup macro prompts the surveyor for a number of these characteristics, and stores them in the corresponding *.INF file in the C:\FN_INFO directory. When these attributes are needed during the execution of a field note macro, the information is read from its corresponding *.INF and pasted into the document. This enables the surveyor to enter these common characteristics only once during the production of documents. The setup macro prompts for the following information: Surveyor's Name; What Surveyed; Group Number, Special Instructions Date, Meridian, State, Township Number (North or South), and Range Number (East or West).

START

There are several standard or customary pages in every set of field notes. These are the page one, general description, field assistants, certificate, cover, and index pages. Formatting of these pages is available through macros of the same name. The start macro consecutively executes these macros in the order above for effective formatting of the customary pages in field notes.

Page One

The page one macro inserts standard information and verbiage into the document. This information consists of the survey definition, history of surveys, execution in accordance verbiage, direction of lines, geographic position, and magnetic declination.

General Description

The general description macro creates and formats a new page and allows for keyboard input of the general description.

Field Assistants

The field assistants macro creates and formats a new page, and enables the surveyor to enter as many assistants as desired. Entering a blank name exits the surveyor from the macro. The capacity field is a pick list of following choices: Cadastral Surveyor, Survey Technician, Survey Aid, or Student Assistant.

Certificate

The certificate macro creates and formats a new page and inserts its corresponding information into the document.

Cover

The cover page macro also creates and formats a new page, and inserts its corresponding information into the document. Because of the necessary centering on the page, the macro provides keyboard entry of the survey heading.

Index

The index macro creates a new page and formats the heading information. It then inserts the rectangular index chart into the document.

CSTUF NOTES

The surveyor now has a document with the common or standard pages in field notes built through the setup and start macros. He or she is now ready to enter the field note (.fn) file from CSTUF. The CSTUF macro inserts the defined field note (.fn) file into the document at the cursor location. It then formats the bearings, distances, accessories, and verbiage found. The *** Point No. #Station** verbiage is left in the document because it is usually very beneficial in a reviewing sense to have the station names next to their descriptions. The **Remove * Point ID's** function in the NOTES pull-down menu removes this verbiage when ready for a final version of the field notes.

Cap Remark Format

The last step in formatting the field note (.fn) file from CSTUF is converting the CAP feature code or remarks into its corresponding cap marking. The Cap Remark Format macro finds each CAP feature code, reads it, and then drafts its corresponding cap marking. The following pages show the results from the setup, start, CSTUF, and cap remark format macros.

DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES, IN
TOWNSHIP No. 2 NORTH, RANGE No. 5 EAST, OF
THE FAIRBANKS'S MERIDIAN, IN THE STATE OF ALASKA

FEET

The following field notes are those of the Dependent Resurvey of a portion of the exterior boundaries, in Township 2 North, Range 5 East, of the Fairbanks's Meridian, in the State of Alaska.

The history of previous surveys are as follows:

History of Surveys Entered Here!

The survey was executed in accordance with the specifications set forth in the Manual of Surveying Instructions, 1973, and the Special Instructions for Group No. 99, Alaska dated December 25, 1996.

Preliminary to the resurvey the lines of the original survey were retraced and a search was made for all corners and other calls of record. Identified corners were remonumented in their original positions; lost corners were restored and monumented at proportionate positions based on the original record. The retracement data were thoroughly verified and only the true line field notes are given herein.

The direction of the lines of this survey refer to the true meridian, and were determined by hour angle observations of the sun. The lines were carried forward by sustained angulation being supplemented by other solar observations taken throughout the progress of the survey. The measurements of these lines were made with an electronic total station.

A magnetic marker, which is referred to as a "DEEP-1" in these notes, was deposited at the base of each monument, so indicated. This marker consist of a magnet, 1 in. Long, 7/8 in. Diam., housed in a cellulose acetate tube, 2 5/8 ins. Long, 1 in. Diam., with 1 in. Sq. Polyethylene end caps.

The geographic position of the S.E. Twp. Cor. As determined by GPS, is as follows:

DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES, IN
TOWNSHIP No. 2 NORTH, RANGE No. 5 EAST, OF
THE FAIRBANKS'S MERIDIAN, IN THE STATE OF ALASKA

FEET

Latitude: 66°21'34" N.

Longitude: 152°55'21" W. "NAD 27"

The mean magnetic declination as determined from numerous readings throughout the survey, is 14° East.

* Point No. # 400500

Point for the sec. cor. of secs. 9 10 15 16 . This cor. position was established by Steve Kopach, Statel Registered Land Surveyor No. 1245, in 1990, recorded in the County1 County Courthouse, and is accepted as a careful and faithful perpetuation of the original cor. position.

Monumented by a iron pipe, 2 ins. diam., loosely set, 4 ins. above ground, with a plastic mkd.

At the corner point

Set an stainless steel post, 30 ins. long, 2 ½ ins. diam., 26 ins. in the ground, over a "DEEP-1", with an steel cap mkd. as shown.

T2N	R5E
S9	S10
S16	S15
1997	

From which the new bearing trees

A cedar, 10 ins. diam., bears N. 43°37' E.
23.3 ft. dist., with nail in base, mkd.

A oak, 25 ins. diam., bears N. 53°33' E.
19.9 ft. dist., with scribing in base, mkd.
BT

Bury the iron pipe alongside the stainless steel post.

From this cor., a power pole no 12345, bears S. 40°07' W. 49.4 ft. dist.

DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES, IN
TOWNSHIP No. 2 NORTH, RANGE No. 5 EAST, OF
THE FAIRBANKS' S MERIDIAN, IN THE STATE OF ALASKA

FEET

Thence, N. $14^{\circ}55'33''$ E., bet. secs. 9 and 10.

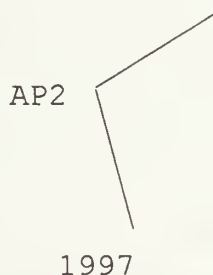
* Point No. # 400540

1046.46 Point for the E. $1/4$ sec. cor. of secs. 10 .This
cor. position was perpetuated by person(s)
unknown.

From which the original bearing trees

A hickory, 20 ins. diam., bears S. $76^{\circ}05'$ W.
31.7 ft. dist., with nothing in base, mkd.

Seat a brass tablet, 3 $1/4$ ins. diam., 3 in. stem
in drill hole, filled with concrete, flush with
ledge with top mkd. as shown.



From which the new bearing trees

A birch, 15 ins. diam., bears N. $11^{\circ}15'$ W.
61.70 ft. dist., with nail in base, mkd.

A maple, 18 ins. diam., bears N. $47^{\circ}37'$ E.
11.5 ft. dist., with nail in base, mkd.

This cor. is located N. $40^{\circ}04'$ E. 49.20 ft. dist.,
from power pole

Thence, N. $58^{\circ}53'13''$ E., bet. secs. 9 and 10.

DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES, IN
TOWNSHIP No. 2 NORTH, RANGE No. 5 EAST, OF
THE FAIRBANKS'S MERIDIAN, IN THE STATE OF ALASKA

FEET

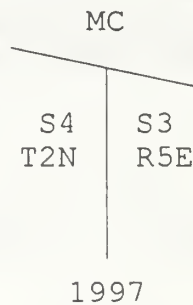
* Point No. # 400600

1519.48 Point for the sec. cor. of secs. 3 4 9 10 . This cor. position is accepted as having been established in good faith using proper methods and procedures.

Monumented by a iron rebar, 1 ins. diam., loosely set, 3 ins. above ground, with no cap

At the corner point

Set an stainless steel sectional rod 40 ins. long, 5/8 in. diam., driven 36 ins. in the ground, with a "DEEP-1" alongside, with an steel cap mkd.



From which

A chisel mark in a granite boulder, 5 ft. above ground, bears S. $4^{\circ}34'$ W. 16.24 ft. dist., to a cross chiseled in the west face, mkd. B + O.

* Pen Up Start New Chain
* Point No. # W1

Thence S. $13^{\circ}52'20''$ E., 55.87 ft.
* Point No. # W2

Thence S. $76^{\circ}58'21''$ E., 100.20 ft.
* Point No. # W3

Thence S. $56^{\circ}43'43''$ E., 49.16 ft.
* Point No. # W4

DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES, IN
TOWNSHIP No. 2 NORTH, RANGE No. 5 EAST, OF
THE FAIRBANKS'S MERIDIAN, IN THE STATE OF ALASKA

FEET

Thence S. $60^{\circ}42'59''$ E., 74.18 ft.

* Point No. # W5

General Description

The land encompassed in this survey is located
somewhere in Alaska.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FIELD ASSISTANTS

Name	Capacity
David R. Roy	Cadastral Surveyor
Theresa A. Roy	Cadastral Surveyor
Allen C. Roy	Survey Technician
Michelle A. Roy	Survey Aid
Gayle D. Roy	Student Assistant

CERTIFICATE OF SURVEY

I, *Kenneth D. Roy*, hereby certify upon honor that, in pursuance of special instructions bearing the date of the *25th day of December, 1996*, I have *Dependently Resurveyed a Portion of the Exterior Boundaries, in Township 2 North, Range 5 East*, of the *Fairbanks's* Meridian, in the State of *Alaska*, which are represented in the foregoing field notes as having been executed by me and under my direction; and that said survey has been made in strict conformity with said special instructions, the Manual of Instructions for the Survey of the Public Lands of the United States, and in specific manner described in the foregoing field notes.

Date

(Cadastral Surveyor)

CERTIFICATE OF APPROVAL

BUREAU OF LAND MANAGEMENT
Springfield, Virginia

The foregoing field notes of the *Dependent Resurvey of a portion of the exterior boundaries, in Township 2 North, Range 5 East, Fairbanks's Meridian, Alaska*, executed by *Kenneth D. Roy* having been critically examined and found correct, are hereby approved.

Date

(Chief Cadastral Surveyor, Eastern States)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FIELD NOTES

OF THE
DEPENDENT RESURVEY OF A PORTION
OF THE EXTERIOR BOUNDARIES OF
TOWNSHIP No. 2 NORTH
RANGE No. 5 EAST

OF THE FAIRBANKS' S MERIDIAN
IN THE STATE OF ALASKA

EXECUTED BY

Kenneth D. Roy
Cadastral Surveyor

Under special instructions dated *December 25, 1996*, approved *December 25, 1996*, which provided for the surveys included under Group Number 99, and authorization/assignment instructions dated *December 25, 1996*.

Survey commenced *January 1, 1997*
Survey completed *January 24, 1997*

INDEX DIAGRAM

Township 2 North, Range 5 East

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Although the example above is small, it illustrates how quickly a rough set of field notes can be drafted. There are several other developed macros to facilitate common field note operations in the production of final field notes. They are now listed.

Update Header

The update header macro enables surveyors to update the current header. The update header macro grabs the text from the existing header allowing the surveyor to edit the text. The updated text is then inserted in the document between two long lines at the cursor location, and into the header of the proceeding page.

Distance

The distance macro prompts the surveyor for a distance and inserts it in the feet or chains column.

Degree Symbol

Inserts the degree (°) symbol in the document at the cursor location.

Long Line

Inserts a long line in the document at the cursor location.

Short Line

Inserts a short line in the document at the cursor location.

Rectangular Cap Marking Macros

The following CAP macros draw common rectangular cap markings. They use the *.INF files in this process. They also solve for remaining section numbers based on the type of cap marking, and the section numbers which may have been entered. For example, the section cap macro prompts for the north east section then inserts the remaining corresponding section numbers and information into the document at the cursor location. The cap marking macros and their matching

icons are East-West Cap  , North-South Cap  , Section Cap  ,

North Cap  , South Cap  , East Cap  , and West Cap .

Lat-Long

The lat-long macro prompts for the degrees, minutes, seconds, and datum of the desired latitude and longitude, and correctly formats and inserts the information into the document at the cursor location.

State Plane

The state plane macro is very similar to the lat-long macro. The state plane macro prompts for X and Y coordinates and inserts that information into the document at the cursor location. It then prompts the surveyor to define how the coordinates were derived and inserts that verbiage into the document.

Certificate of Transcript

The Certificate of Transcript usually is located on the certificate page in the duplicate set of field notes. The certificate of transcript macro inserts its verbiage into the document at the cursor location.

Missouri State Plane

The Missouri state plane macro is only used with the corner recordation template. The State of Missouri requires state plane coordinate listings on the bottom of all corner recordation sheets. The Missouri State Plane macro calls the state plane macro, and then formats the information at the bottom of the current page.

Summary

The effort involved in the generation and review process of final plats and field notes of cadastral surveys has long been a time consuming, tedious, and error prone portion of the "Field to Finish" process. This thesis has provided the tools and procedures for effective collection and manipulation of descriptive and numerical observations into plats and field notes.

CEFB now provides several tools and functions for the practical initial (pre boundary analysis) collection of survey data through the index file, as well as the capabilities of collection of descriptive and linework information (post boundary analysis) for the production of plat and field notes through feature codes and chain collection. There are also several other enhancements in CEFB that have increased the efficiency of day to day survey operations.

The DXF program now provides the ability to read CEFB chain and observation files for automatic production of linework and symbology in AUTOCAD. The CSTUF program provides capabilities for rounding, sorting, editing, and structuring of descriptive and numerical survey data to be brought into word processing software (WordPerfect). The field note macros and templates in WordPerfect provide the final steps of formatting descriptions, accessories, bearings, distances, headers, and cap markings.

These procedures will reduce the amount of time required for office production and review of cadastral surveys. With collected linework and descriptions from the cadastral surveyors in the field, reviewers can quickly produce rough draft plats and field notes without typing a description, distance, or bearing in WordPerfect, and plats without drawing a line in AUTOCAD.

These procedures, however, will never produce final versions of plat and field notes. Each survey is unique in that it has its own special characteristics that cannot be automated. These procedures do, however, provide the basic foundation for the effective production of rough draft plats and field notes. Small amounts of editing can convert these items to final form.

The most important concept in this process is that the production of plats and field notes starts in CEFB. Tailored feature code and index files are crucial for the efficient production of field notes and plats. Cadastral surveyors must use these files in the field to write their field notes and produce linework for plats. Collection of this information in digital form in the field eliminates a time consuming part of the way field notes and plats have been produced in the past. Surveyors can complete corner descriptions, and collect the linework of the boundary in a chain, as they observe the information in the field. The time spent collecting this information in the field will greatly reduce the time spent producing these products in the office.

APPENDIX A - Instrument setup

Lietz Older Total Stations

Models:

SET2, SET2A, SET3, SET3A, SET4-4A

These older Lietz/Sokkia total stations do not allow a remote field computer to control the instrument measurement mode, but they do dump data. For one of the more recent types see the next entry for Lietz/SOKKIA Newer total stations. For these older total stations the operator must key the instrument for each measurement and set the modes (HV) or distance, manually in the process. If desired the user can also zero the plates on the back sight, but this is not mandatory.

These instruments communicate at 1200 baud. If you make the Lietz SET 234/a selection from the CEFB Instrument menu, you must set your instrument communications parameters to 1200 Baud. On many of these instruments, this is not an option and is preset. Thus try it first, then if doesn't work see if there is an option to set the serial port speed.

The instrument operator must place the instrument in the correct measurement mode for the proper data to be transmitted. The mode the instrument needs to be set at the instrument keyboard, corresponding to the type of data CEFB is trying to gather.

When polling the instrument with CEFB the operator will be prompted to hit either the:

[CA][th] keys, or the

[CA][slope] keys.

The [th] theodolite key refers to a key which usually has a theodolite graphic on it. This will cause the plates to be read and the data ready for CEFB. The operator then hits any key on the CEFB machine to clear the prompt window and the data will be accepted. This prompt occurs on the back sight and at any other time while in HV mode. When at the back sight the operator may also SET 0 to zero the plate before hitting the [CA][th] key combination.

The [slope] theodolite key refers to a key which indicates slope distance by the top of a triangle graphic. This selection will then cause the plates to be read and a distance measurement to begin. At any time the operator can then hit any key on the CEFB machine to clear the prompt window and the data will be accepted when the distance is taken, providing the instrument timeout period has not elapsed. You can also elect to wait until a distance has been read before hitting the key on CEFB. This prompt occurs at any foresight in HVD mode. There is no distinction made between fine and course mode on CEFB with this instrument selection.

Lietz/Sokkia Newer Total Stations

Models: SET2B, SET2C, SET3B, SET3C, SET4B, SET4C

These newer Lietz/Sokkia total stations allow full remote control by CEFB. To use an older instrument see LIETZ, above. For these newer instruments Select SOKKIA SET 234/bc from the instrument selection menu.

The CEFB interface must be properly set for RS-232 communications to take place. Follow manufacturer's documentation for setting the communications protocol to 2400 baud, No parity, and 1 Stop Bit. It is optional if you would like to invoke the checksum, although it is not necessary.

Pentax Total Stations

Models: PTS-10, PTS-II series, also PTS-III

Pentax total stations do not allow a remote field computer to control the instrument measurement mode. The total station can however, be instructed to begin the measurement cycle and transmit the data by CEFB once the measurement mode is selected from the instrument keyboard. The instrument operator will select between theodolite mode, for HV observations, or total station mode for HVD observations.

The instrument operator must place the instrument in the correct measurement mode for the proper data to be transmitted. The mode the instrument needs to be set at the instrument keyboard, corresponding to the type of data CEFB is trying to gather.

To place the instrument in theodolite mode (H, HV Observations):

- 1) Instrument must be on
- 2) Press the V/H [7] key, to place the instrument into angle measurement mode

To make a measurement with CEFB:

- 1) Press the POLL function key on the field computer

To place the instrument in total station mode (HVD, HD, VD, D Observations):

- 1) Instrument must be on
- 2) Press the SLP/V [5] key to place the instrument into an angle/distance measurement mode

To make a measurement with CEFB:

- 1) Press the POLL function key on the field computer

Note: Make sure instrument is set for Zenith at 0 degrees.

The instrument will automatically go into an AIM MODE, and will cycle until the EDM stabilizes. When the EDM stabilizes, the data is then transmitted to the field computer.

The PTS-III instruments can also be used by proper switch settings. These are to set all the switches on the 3rd row are set OFF with the exception of switch 5, which should be on. You have to be sure to set the gun to HV mode each time you turn it on.

Topcon Total Stations

Models: GTS-3B, GTS-3C, GTS-4

Topcon Total stations allow fully automatic control of instrument measurement mode by FIELD PACK. A BCC data checking system is employed to insure the integrity of the transmitted data.

To set the instrument serial port for use, the following one-time-only procedure must be followed the first time the instrument is to be used with the field computer. It is NOT necessary to perform this procedure again, unless the user has changed the settings that this procedure has implemented.

Setting up Topcon GTS-3B

DISPLAY

- | | | |
|--|---------------|------------|
| 1) Turn on the power switch while pressing the [R/L] key continuously for about 1 second | " 0 SET " | |
| 2) Rotate the telescope to make zero-setting | " FAC.XX.XX " | |
| 3) Press the [lightbulb] key | " 00 " | |
| 4) Press the [V/H] key twice | " 12.00.00 " | |
| 5) Press the [R/L] key | " 12.00.01 " | |
| 6) Press the [0 SET] key | " 12.01.01 " | |
| 7) Press the [V/H] key twice | " 14 " | |
| 8) Press the [0 SET] key | " 14 SET " | *See Notes |
| 9) Turn the power off | | |

The previous procedure is performed to change the mode "12.00.XX" to "12.01.XX".

Notes: * If the display was " 14 E99 ", turn off the power and repeat the procedure from step 1.
* When the GTS-3B is used with the TOPCON Data Collector FC-1/2 or Data Entry Keyboard DK-5, The above procedure EXCEPT step 5) must be repeated to restore the original condition of the instrument to "12.00.00".

In the case of the second note, step 4) and 6) will differ from the above as follows:

Action for Topcon GTS-3B	DISPLAY
1) Turn on the power switch while pressing the [R/L] key continuously for about 1 second	" 0 SET "
2) Rotate the telescope to make zero-setting	" FAC.XX.XX "
3) Press the [lightbulb] key	" 00 "
4) Press the [V/H] key twice	" 12.01.00 "
5) Omit this step	
6) Press the [0 SET] key	" 12.01.00 "
7) Press the [V/H] key twice	" 14 "
8) Press the [0 SET] key	" 14 SET "
9) Turn the power off	

Note: Make sure the DIP switch in the RS-232 Port is set to NO ECHO. This is accomplished by removing the four screws and pulling out the port cover, which pulls the attached board out. A bank of two dip switches are found on the board and should be set to switch 1 ON, switch 2 OFF.

Setting up Topcon ET-2	DISPLAY
1) Turn on the power switch while pressing the meter/feet selector switch continuously until buzzer sound is stopped. The display will be blank except the meter/feet and the degree/grad unit.	" FAC 10.10 "
2) Operate the [V/H] switch, instrument will a flashing first digit (right) will be displayed if it is not changed before	" 00000000 "
3) Move a flashing digit to the 2nd digit. A flashing digit can be shifted each time by operating the [V/H] switch.	" 00000000 "
4) Operate the [REC] switch, the 2nd digit will be changed to a "1"	" 00000010 "
5) Operate the [F] switch. Nothing but the meter/feet and the degree/grad unit will be displayed, indicating the setting is complete.	" "
6) Turn the power off.	

Note: When the ET-2 is used with the TOPCON Data Collector FC-1/2 or Data Entry Keyboard DK-5, The above procedure must be repeated with the exception described below to get the original condition of the instrument

Action for Topcon ET-2

Display

- 1) Turn on the power switch while pressing the meter/feet selector switch continuously until buzzer sound is stopped. The display will be blank except the meter/feet and the degree/grad unit.
" FAC 10.10 "
- 2) Operate the [V/H] switch
" 00000010 "
- 3) Move a flashing digit to the 2nd digit.
A flashing digit can be shifted each time by operating the [V/H] switch.
" 00000010 "
- 4) Operate the [REC] switch, the 2nd digit will be changed to a "0"
" 00000000 "
- 5) Operate the [F] switch. Nothing but the meter/feet and the degree/grad unit will be displayed, indicating the setting is complete.
" "
- 6) Turn the power off.

Setting up Topcon GTS-4

This procedure is used to add the ASCII characters CRLF to the end of the data output strings for connection to a computer.

- 1) Turn on the power switch while pressing the [2] key continuously for about 1 second.

DISPLAY

[PARAMETERS MENU]

- 2) The parameters menu is displayed

```
PARAMETERS ½
1:ANGLE
2:DIST
3:DATA-OUT
```

- 3) Press the [3] Key

```
DATA-OUT ½
CRLF:OFF

SET ITEM--SLCT
```

- 4) Press the [F4] Key

```
DATA-OUT ½
CRLF:ON

SET ITEM--SLCT
```

- 5) PRESS the [F1] Key

DATA-OUT

<SET!>

- 6) Display is returned to the Parameters menu
7) Turn off the power

To make a measurement with CEFB:

- 1) Press the POLL function key on the field computer

Setting up Topcon GTS300 Series

The GTS300 Series of instruments has been successfully used with CEFB with proper configuration of the instrument. Consult the Instrument Manual to see how to access the MODE settings.

MODE SETTINGS FOR TOPCON 300 SERIES:

Mode three is the data collection mode. It contains 8 digits which read from RIGHT TO LEFT. These should be set as follows:

1=0, 2=1, 3=0, 4=1, 5=0 6 through 8 are not used and should be set to 0.

The other MODE settings (1 and 2) are for manual use and should be set accordingly for that use.

Wild Total Stations

Models: T(C)1000, T1010

Need to Place Jerry's Doc's concerning the instrument setup for the wild instruments.

Pentax Total Stations

Need Something here !!!!!

APPENDIX B - Hewlett Packard Data Transfer

Hewlett Packard - Connectivity Pack

This section contains a brief explanation of the installation procedure for the HP Connectivity Pack, followed by an explanation of the file transfer program. If any problems are encountered, refer to the 'Connectivity Pack User's Guide'.

Installation

1. Insert disk 1 included with the Connectivity Pack into the appropriate size disk drive (usually drive A).
2. type: *a:* <Enter> (or the appropriate disk drive letter) *install* <Enter>
3. Follow the predefined answers as installation occurs.
4. When installation is complete, remove the disk and reboot the computer. This can be done by pressing the <Ctrl> <Alt> keys all at once, or by turning the computer off and then on.

Check the autoexec.bat file

1. At the DOS prompt type: *set* <Enter>
2. Look after PATH to see if the Connectivity Pack directory is included in the string. For example, C:\CPACK should exist if installation to the C drive was made. If the directory exists in the path, you are done, otherwise continue with step 3.
3. If the C:\CPACK (or appropriate directory) does not exist in the path, use a text editor to add it to the autoexec.bat file, then reboot the PC. This will allow you to start the file transfer program from the DOS prompt. If you do not wish to edit the autoexec.bat file, you can still use the file transfer program by changing to the c:\cpack directory before activating the program.

Setting the HP for the Filer

1. Start the filer on the HP by pressing the blue *Filer* key. It is located just below the <Esc> key.
2. Press the <Menu> key.
3. Press the letter *R* for Remote-Set.
4. Press the letter *C* for Configuration.
5. Press the letter *I* for Interface.
6. Press <Enter> to select 1 (Com1).
7. Press *B* to select Baud.
8. Press the number *6* to select 6 (19200).
9. Press *Q* to quit.
10. Optional: Press *S* to save these settings to a file. At the C:_Dat*.FCF prompt, type any filename and press <Enter>.
11. Press *Q* to quit the Filer Menu.

Setting the PC for the Filer

1. Connect the PC and the HP95 using the serial cable. This cable will have one end with a small 4 pin connector for the HP95, and a nine or twenty five pin connector for the PC. If you have any questions, see pages 1-4 and 1-5 in the Connectivity Pack User's Guide.
2. On the HP, Open the Filer as you did in step 1 during the HP95 Setup.
3. On the PC type: *app* <HP Model> <Enter> . This will start the APP program. If the program did not start from the DOS prompt, try logging to the C:\cpack directory and repeat this step.
4. Simultaneously press the <Alt> key and the number 2 to start the Filer application.
5. Simultaneously press <Alt> - <F10> , then *R*, and finally *C* to view the Filer remote settings.
6. Make sure the *Interface* settings match the serial port being used on the PC. Generally, COM1 is the nine pin serial port that connects the mouse to the PC. If your not sure, try several combinations. To change the COM port press the letter *I* and then select the proper COM port by pressing the corresponding number 1-4.
7. Make sure the *Baud* setting is set to 19200. To change it, press the letter *B*, then select the baud rate by pressing the corresponding number 1-7.
8. Press the *Q* twice to quit the remote settings and display the current directory.

Transferring Files

1. On the HP95, open the Filer Menu. This is the only step performed on the HP.
2. On the PC, type: *app* <HP Model> <Enter> from the DOS prompt to start the APP program.
3. Simultaneously press <Alt> and the number 2 to start the Filer application.
4. Press <F7> Split, then <F6> Remote to split the screen and establish a remote connection. The display on the PC will show a *local* (PC) directory and a *remote* (HP95) directory similar to Figure B.1.

Filer	02/24/93	9:49	pm
Remote	NoDirs		Local

C:\		C:\	
_DAT	<DIR>	AAA	<DIR>
_CHKDSK	EXE	AERO	<DIR>
_COMMAND	COM	CPACK	<DIR>
_TF	COM	DOS	<DIR>
_CARLOAN	WK1	HYPER	<DIR>
_CFLOW	WK1	JF	<DIR>
_EXPENSE	WK1	NORTON	<DIR>
_HOMEBUY	WK1	PCTOOLS	<DIR>
_STAT	WK1	WP51	<DIR>

Copy	Local	Rename	Move
Help	Delete	Goto	Full Tag

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10

Figure B.1: Remote and Local File Windows on the PC

5. Display the *destination directory*. This is the directory that you wish a file to go into.
 - a. First, use the left or right arrows to toggle between the local (PC) or remote (HP95) window.
 - b. Second, to change to the desired directory, press <F5> GOTO, and then enter the directory name, or highlight the directory name and press <Enter>.

Note: If you are going to transfer a field file to the CMM directory on the PC, first make sure that you are on the Local (right) side of the screen. If the CMM directory is on the C drive, just highlight the directory and press <Enter>. The third line of the screen will update to C:\CMM. If your CMM directory is on another drive, press <F5>, type (drive letter):, and press <Enter>. Now you may highlight the CMM directory and press <Enter>.

6. Display the *source directory*. This is the directory which contains the file that you wish to transfer. Steps a & b above apply here also.

Note: To change to the CEFB directory on the A drive of the HP95, make sure that you are on the Remote (left) side of the screen. Press <F5>, and then type a: <Enter> to display the directories on the A drive. Now highlight the CEFB directory, and press <Enter> to display the list of files..

7. Highlight the file to be transferred.
8. Transfer the file by pressing <F2>, and then <Enter>.
9. When finished transferring the file, simultaneously press <Alt> - <F6> to break the remote connection.
10. Press MENU by pressing <Alt> <F10> and then Q to quit.

11. Simultaneously press <Alt> and 0 to exit the APP95 program. Use the zero above the letters, not the zero on the keypad.
12. On the HP95, select the Menu button and quit. If you are not using an AC adapter, unplug the serial cable to preserve battery line.

If you wish to transfer more than one file at a time, see page 2-5 of the Connectivity Pack User's Guide.

Data File Transfer using ProComm Plus

This is just one of several methods to accomplish data file transfers.

Setting up the PC

1. Run PCPLUS.
2. Once in PCPLUS press ALT P and set the following parameters:
Baud Rate = 19200, Parity = None, Data Bits = 8, Stop Bits = 1, Port = COM 1
- 3.. Once you complete these settings press ALT S to save. This will save these settings in the CMM directory so whenever you call up PCPLUS in that directory you will be all set to transfer.

Setting up the HP

1. From the opening screen press the "BLUE" COMM key. These key functions are only available from the opening screen. If you have shelled to DOS or are in some other program they will not be active and you must completely exit back to the opening screen.
2. After pressing the "BLUE" COMM key the display reads; Datacomm and the current date and time at the top of the screen with the rest of the screen blank.
3. Press the "WHITE" MENU key, bottom row, 2 keys left of the 0 key. A new menu will appear at the top with Settings highlighted.
4. Press enter to select the highlighted Settings choice.
5. A new menu will appear. Select Config. This can be done by cursoring to the Config or simply hitting C, a new menu will appear.
6. This is the configuration menu for the communications setup. The HP must be set up exactly the same as the PC. Set up is as follows:
 - a. Highlight Port and hit enter, a new menu appears at the top of the screen. Highlight Interface and enter. Highlight 1 <Com1> and enter. You will be returned to the previous menu.
 - b. Highlight Port again and enter. Highlight Baud and enter. Highlight 6 <19200> and enter.

- c. Highlight Port again and enter. Highlight Stop and enter. Highlight 1 and enter.
- d. Highlight Port and enter. Highlight Parity and enter. Highlight None and enter.
- e. Highlight Port and enter. Highlight Char and enter. Highlight 8 and enter.
- f. Now highlight Terminal and enter (You can skip Dial). Highlight Emulation and enter. Highlight None and enter.
- g. Highlight Terminal and enter. Highlight Wrap and enter. Highlight Disable and enter.
- h. Highlight Terminal and enter. Highlight Backspace and enter. Highlight Backspace and enter.
- I. Highlight Other and enter. Highlight Echo and enter. Highlight Disable and enter.
- j. Highlight Other and enter. Highlight flow and enter. Highlight None and enter.
- k. Highlight Other and enter. Highlight Duplex and enter. Highlight Full and enter.
- l. Highlight Capture and enter. Highlight None and enter.
- m. Skip X-late and Script. These are not needed and should be blank on the setup screen.
- n. Highlight Quit and enter. A new menu will appear, highlight Save and enter. A new screen will appear asking where you want to save the setup stuff. If you simply enter it will be saved to the C:\DAT\ directory as DEFAULT.DCF which is what you want to do, so hit enter. If you get a message: Overwrite existing file? <Y/N> type in Y and enter.
- o. You are now finished setting up the HP. Highlight Quit and enter. Press the "WHITE" MENU key now. Highlight Quit and enter. You will be returned to the opening screen. The setup just created will not need to be done again unless you change something.

Transferring Files

1. Connect the PC to the HP-95 with the serial interface cable, be sure to use COMM 1 on the PC, usually the same port as the mouse uses.
2. On the PC, go to the CMM directory and run PCPLUS by typing the full path to do this, ie. C:\PCPLUS.
3. Press pageup (PgUp) (UpLoad a file) on the PC to upload a file to the HP-95. You will see a Protocol menu, select KERMIT (No. 2). A menu will appear asking for the file name to be transferred. Type in <Filename>, DO NOT HIT ENTER YET.
4. On the HP, from the opening screen, press the "BLUE" COMM key. Then press the "WHITE" MENU key. If you want to verify the set up stuff, highlight settings and enter, read the settings to see if they are correct. If OK, highlight Quit and enter, if not you will need to set them as above or highlight USE and enter. This will bring up the settings that were saved in the setup process we did above, then press enter to use those saved settings. Now highlight Quit and press enter.
5. Now press the "WHITE" MENU key. Highlight Transfer and enter. Highlight Kermit and enter. Highlight Options and enter. Highlight File and enter. Highlight Binary and press enter.
6. Highlight RECEIVE and press enter.

7. A new menu will appear with a flashing cursor. Type in the file name and path on the HP that you are transferring.
8. Now hit enter on the HP and immediately enter on the PC. If all was done correctly the file should begin transfer to the HP. If something goes astray, follow the menu selections and abort the transfer. Check all setup stuff and try again.

Xmodem protocol always transfers full 128 byte records. So, if your file is not an exact multiple of 128 bytes in length, which it almost always is not, XMODEM will add bytes onto the end of the file. This can cause FFFTOBS to indicate an invalid record type, but usually the OBS file is okay. KERMIT protocol is much faster than XMODEM to transfer. The key to all this is the pageup (PgUp) and pagedown (PgDn) on the PC.

To pass a file from the HP to the PC the steps are very similar. On the HP, from the opening screen, press the "BLUE" COMM key, then the "WHITE" MENU key. If all the settings are OK highlight transfer and enter. Highlight kermit and enter. Highlight Options and enter. Highlight file and enter. Highlight Binary and enter. Highlight Send and enter. At this point you are presented with a menu of the C:*.* directory. Highlight the file you want to transfer and enter. On the PC, run PCPLUS from the CMM directory as before. Select the pagedown (PgDn) key (Down Load a file) and select KERMIT from the protocol menu. The file will begin to transfer at this time.

APPENDIX C - Observation and Chain File for DXF Program

Abbreviated Observation File

R CEFB v1.0006 Hunit= ft Vunit= ft
R MH1 MANHOLE: Manhole
R MH2 MANHOLE: Manhole
R TREE1 TREE: A ash, 12 ins. diam.
R MB1 MAIL_BOX: Mail box
R LTP1 LIGHT_POLE: Light pole
R FHY1 FIRE_HY: Fire hydrant
R PIPE1 PIPE: Pipe
R P2 PILE: Pile
S 1 2
B 0 0 0.0
F B1
F B2
F B3
F B4
F B5
F B6
F B7
F B8
F B9
F B10
F B11
F B12
F B13
F B14
F B15
F B16
F CRK1
F CRK2
F CRK3
F CRK4
F CRK5
F CRK6
F CRK7
F CRK8
F FNC1
F FNC2
F FNC4
F FNC5
F FNC6
F FNC7
F FNC8

F FNC9
F FNC10
F MH1
F MH2
F FHY1
F LTP1
F MB1
F TREE1

Chain File

BUILDING No #1: building owned by FRED

BUILDING No #2: house owned by TOM

BUILDING No #3: garage owned by Ray

BUILDING No #4: shed owned by Hans

BUILDING S B1 B2 B3 B4 B1 0 B5 B6 B7 B8 B5 0 B9 B10 B11 B12 B9 0 B13 B14 B15 B16 B13
0

CREEK C CRK1 CRK2 CRK3 CRK4 CRK5 CRK6 CRK7 CRK8

FENCE S FNC1 FNC2 FNC3 FNC4 FNC5 FNC6 C FNC7 FNC8 FNC9

APPENDIX D - Observation Files with Recorded Feature Codes

File One

R CEFB v12/06/96 Hunit= ft Vunit= ft

R 400500 **POINT_FOR**: Point for the sec. cor. of secs. 9 10 15 16 . _This_cor. position was _established by Steve Kopach, State1 Registered Land Surveyor No. 1245, in 1990, recorded in the County1 County Courthouse, and is accepted as a careful and faithful perpetuation of the original cor. position.

R 400500 **MON_FD**: Monumented by a iron pipe, 2 ins. diam., loosely set, 4 ins. above ground, with a _plastic mkd.

R 400500 **AT**: At the corner point

R 400500 **MON_SET**: Set an stainless_steel post, 30 ins. long, 2 ½ ins. diam., 26 ins. in the ground, over a "DEEP-1", with _an steel cap mkd. as shown.

R 400500 **CAP**: CAP rectangular _marking interior standard 4 _sections — S10 S15 S16 S9 1997

R 400500 **FROM_WHICH**: From which the _new bearing trees 2trees A cedar, 10 ins. diam., bears ^(400500 BT1) N. 44°56'16" E. 2308.81 ft. dist. , with nail in base, mkd. TREE A oak, 25 ins. diam., bears ^(400500 BT2) N. 54°52'42" E. 1962.42 ft. dist. , with scribing in base, mkd. BT

R 400500 **BURY**: Bury the iron_pipe alongside the stainless_steel post.

R 400500 **FROM_THIS**: From this cor., a power pole no 12345, bears ^(400500 POLE1) S. 41°51'33" W. 498842.97 ft. dist.

R 400540 **POINT_FOR**: Point for the E. 1/4 sec. cor. of secs. 10 . _This_cor. position was _perpetuated by _person(s)_unknown.

R 400540 **MON_SET**: Seat a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with ledge with top mkd. as shown.

R 400540 **CAP**: CAP angle_point _marking Lines From Center: 2 ^(400540 400500) S. 16°15'08" W. ^(400540 400600) N. 60°12'41" E. 1997

File Two

R CEFBv12/06/96 Hunit= ft Vunit= ft

R 400540 **THIS_COR.**: This cor. is located $\wedge$ (POLE1 400540) N. $40^{\circ}55'10''$ E. 499786.64 ft. dist. , from power pole

R 400540 **FROM_WHICH_FD**: From which the original bearing trees TREE A hickory, 20 ins. diam., bears $\wedge$ (400540 BT3) S. $77^{\circ}25'01''$ W. 381.66 ft. dist. , with nothing in base, mkd.

R 400540 **FROM_WHICH**: From which the new bearing trees 2trees A birch, 15 ins. diam., bears $\wedge$ (400540 BT4) N. $9^{\circ}55'07''$ W. 617.57 ft. dist. , with nail in base, mkd. TREE A maple, 18 ins. diam., bears $\wedge$ (400540 BT5) N. $48^{\circ}56'17''$ E. 1123.34 ft. dist. , with nail in base, mkd.

R 400600 **MON_FD**: Monumented by a iron rebar, 1 ins. diam., loosely set, 3 ins. above ground, with no_cap

R 400600 **AT**: At the corner point

R 400600 **MON_SET**: Set an stainless_steel sectional_rod 40 ins. long, 5/8 in. diam., driven 36 ins. in the ground, with a "DEEP-1" alongside, with_an steel cap mkd.

R 400600 **CAP**: CAP rectangular_marking interior meander $\equiv$ S3 S4 $\wedge$ (BT1 BT5) N. $77^{\circ}35'34''$ W. 1997

R 400600 **POINT_FOR**: Point for the sec. cor. of secs. 3 4 9 10 . This_cor. position is_accepted as_having_been established in good faith using proper methods and procedures.

R 400600 **FROM_WHICH**: From which chisel A chisel mark in a granite boulder, 5 ft. above ground, bears $\wedge$ (400600 BT6) S. $5^{\circ}53'48''$ W. 1642.87 ft. dist. , to a cross chiseled in the west face, mkd. B + O.

APPENDIX E - Resulting Remark (.rem) File from MakeRem Function in CSTUF

* Point No. # 400500

POINT_FOR: Point for the sec. cor. of secs. 9 10 15 16 . This cor. position was established by Steve Kopach, State1 Registered Land Surveyor No. 1245, in 1990, recorded in the County1 County Courthouse, and is accepted as a careful and faithful perpetuation of the original cor. position.

MON_FD: Monumented by a iron pipe, 2 ins. diam., loosely set, 4 ins. above ground, with a plastic mkd.

AT: At the corner point

MON_SET: Set an stainless steel post, 30 ins. long, 2 ½ ins. diam., 26 ins. in the ground, over a "DEEP-1", with an steel cap mkd. as shown.

CAP: CAP rectangular marking interior standard 4 sections — S10 S15 S16 S9 1997

FROM_WHICH: From which the new bearing trees 2trees A cedar, 10 ins. diam., bears N.\$43°37'\$E. 23.3\$ft. dist., with nail in base, mkd. TREE A oak, 25 ins. diam., bears N.\$53°33'\$E. 19.9\$ft. dist., with scribing in base, mkd. BT

BURY: Bury the iron pipe alongside the stainless steel post.

FROM_THIS: From this cor., a power pole no 12345, bears S.\$40°07'\$W. 49.4\$ft. dist.

* Point No. # 400540

POINT_FOR: Point for the E. 1/4 sec. cor. of secs. 10 . This cor. position was perpetuated by person(s) unknown.

FROM_WHICH_FD: From which the original bearing trees TREE A hickory, 20 ins. diam., bears S.\$76°05'\$W. 31.7\$ft. dist., with nothing in base, mkd.

MON_SET: Seat a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with ledge with top mkd. as shown.

CAP: CAP angle point marking Lines From Center: 2 165° 58° AP2 1997

FROM_WHICH: From which the new bearing trees 2trees A birch, 15 ins. diam., bears N.\$11°15'\$W. 61.7\$ft. dist., with nail in base, mkd. TREE A maple, 18 ins. diam., bears N.\$47°37'\$E. 11.6\$ft. dist., with nail in base, mkd.

THIS_COR.: This cor. is located N.\$40°04'\$E. 49.2\$ft. dist., from power pole

* Point No. # 400600

POINT_FOR: Point for the sec. cor. of secs. 3 4 9 10 . This cor. position is accepted as having been established in good faith using proper methods and procedures.

MON_FD: Monumented by a iron rebar, 1 ins. diam., loosely set, 3 ins. above ground, with no cap

AT: At the corner point

MON_SET: Set an stainless steel sectional rod 40 ins. long, 5/8 in. diam., driven 36 ins. in the ground, with a "DEEP-1" alongside, with an steel cap mkd.

CAP: CAP rectangular marking interior meander = S3 S4 281° 1997

FROM_WHICH: From which chisel A chisel mark in a granite boulder, 5 ft. above ground, bears S.\$4°34'\$W. 16.2\$ft. dist., to a cross chiseled in the west face, mkd. B + O.

APPENDIX F - Resulting Field Note (.fn) File from Field Function in CSTUF

* Point No. # 400500

Point for the sec. cor. of secs. 9 10 15 16 . This cor. position was established by Steve Kopach, State1 Registered Land Surveyor No. 1245, in 1990, recorded in the County1 County Courthouse, and is accepted as a careful and faithful perpetuation of the original cor. position.

Monumented by a iron pipe, 2 ins. diam., loosely set, 4 ins. above ground, with a plastic mkd.

At the corner point

Set an stainless steel post, 30 ins. long, 2 ½ ins. diam., 26 ins. in the ground, over a "DEEP-1", with an steel cap mkd. as shown.

CAP rectangular marking interior standard 4 sections $\perp$ S10 S15 S16 S9 1997

From which the new bearing trees

* IndentA cedar, 10 ins. diam., bears N.\$43°37'\$E. 23.3\$ft. dist., with nail in base, mkd.

* IndentA oak, 25 ins. diam., bears N.\$53°33'\$E. 19.9\$ft. dist., with scribing in base, mkd. BT

Bury the iron pipe alongside the stainless steel post.

From this cor., a power pole no 12345, bears S.\$40°07'\$W. 49.4\$ft. dist.

* Brg N. 14°55'33" E., bet. secs. 9 and 10.

* Dist 1046.46

* Point No. # 400540

Point for the E. 1/4 sec. cor. of secs. 10 . This cor. position was perpetuated by person(s) unknown.

From which the original bearing trees

* IndentA hickory, 20 ins. diam., bears S.\$76°05'\$W. 31.7\$ft. dist., with nothing in base, mkd.

Seat a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with ledge with top mkd. as shown.

From which the new bearing trees

* IndentA birch, 15 ins. diam., bears N. $11^{\circ}15'$ W. 61.7\$ft. dist., with nail in base, mkd.

* IndentA maple, 18 ins. diam., bears N. $47^{\circ}37'$ E. 11.5\$ft. dist., with nail in base, mkd.

This cor. is located N. $40^{\circ}04'$ E. 49.20\$ft. dist., from power pole

* Brg N. $58^{\circ}53'13''$ E., bet. secs. 9 and 10.

* Dist 1519.48

* Point No. # 400600

Point for the sec. cor. of secs. 3 4 9 10 . This cor. position is accepted as having been established in good faith using proper methods and procedures.

Monumented by a iron rebar, 1 ins. diam., loosely set, 3 ins. above ground, with no cap

At the corner point

Set an stainless steel sectional rod 40 ins. long, $5/8$ in. diam., driven 36 ins. in the ground, with a "DEEP-1" alongside, with an steel cap mkd.

CAP rectangular marking interior meander $\equiv$ S3 S4 N. $78^{\circ}55'$ W. 1997

From which

* IndentA chisel mark in a granite boulder, 5 ft. above ground, bears S. $4^{\circ}34'$ W. 16.2\$ft. dist., to a cross chiseled in the west face, mkd. B + O.

* Pen Up Start New Chain

* Point No. # W1

Brg S. $13^{\circ}52'20''$ E., 55.87\$ft.

* Point No. # W2

Brg S. $76^{\circ}58'21''$ E., 100.20\$ft.

* Point No. # W3

Brg S. $56^{\circ}43'43''$ E., 49.16\$ft.

* Point No. # W4

Brg S. $60^{\circ}42'59''$ E., 74.18\$ft.

* Point No. # W5

APPENDIX G - Feature Codes

Syntaxes of Feature Codes

[]

Produces a pick list of items within the brackets as separated by a space. If one of the selections within the brackets and pick list matches the identifier of another feature code, control is brought to that particular feature code in the execution of the feature code. This is called branching. The following are two examples of the correct use of the [] brackets to produce pick lists in CEFB when executing a feature code.

[Atlantic Creek Lake Pacific River]	→	Atlantic Creek Lake Pacific River		[A_point_on Corner_of End_of Intersection_of]	→	A_point_on Corner_of End_of Intersection_of
-------------------------------------	---	---	--	---	---	--

Items within the brackets have manually been placed in alphabetic order to take advantage of the hot key functionality available within pick lists in CEFB.

< >

Produces limited prompts defined by the length of the text with the < > . The user is allowed to input anything within the determined length too answer the prompt correctly. The following are two examples of a typical limited prompts where the underline line is the prompt area.

<DIAM? (IN.) >	→	_____	<ROAD NAME? >	→	_____	ROAD NAME?	_____
----------------	---	-------	---------------	---	-------	------------	-------

< ~ >

Produces unlimited prompts in which users can enter as much information as desired. This prompt is completed by pressing the enter key on a blank line. It is recommend to have one of these prompts in each feature code to give users the ability to detail unique aspects of the object being described without any restrictions. The following is an example of an unlimited prompt where the underline line is the prompt area.

< ADD? ~ >	→	_____	ADD?	_____
			< Enter > to End	

#

When the # symbol is immediate followed by another existing feature code identifier, control is brought to that particular feature code in the execution of the feature code. This syntax should only be used at the end of a feature code because control cannot be brought back to a feature code once it has left. One would also not want to branch to the same feature code. This would create an infinite loop. The HEADING feature code below in the CEFBPREF set of feature codes displays use of the # symbol.

#BD

Prompts the user to define FROM and TO points which defines the inverse bearing and distance which in turn is positioned into the executing feature code. It one of the inputted FROM and TO points are not in the CEFB coordinate file, the user will then be prompted to manually enter the bearing and distance.

#B

Performs the same functionality as the #BD function described above except only the bearing is positioned into the executing feature code.

#D

Performs the same functionality as the #BD function described above except only the distance is positioned into the executing feature code.

BUILDING	[N NE E SE S SW W NW] cor. of [building deck foundation garage house patio shed], <Describe~>
CLOSING_ANG	Closing Angle
CONTROL	<Name of Control Station> control station, established <Year?>, <ADD~>
CREEK	[Center Left_bank Right_bank] of [Blueberry Camp_One Eddy Pipestone Rock] Creek, <HOW WIDE? (LKS.)> lks. wide, course #B <ADD~>.
FENCE	[A_point_on Corner_of End_of Intersection_of The_projected] [a_new an_old] [barbed_wire chainlink electric wire wooden] fence, bears #B and #B <ADD~>.
End_of	[a_new an_old] [barbed-wire chainlink electric wire wooden] fence, bears #B <ADD~>.
A_point_on	[a_new an_old] [barbed-wire chainlink electric wire wooden] fence, bears #B and #B <ADD~>.
Intersection_of	[a_new an_old] [barbed_wire chainlink electric wire wooden] fence, bears #B with [a_new an_old] [barbed_wire chainlink electric wire wooden] fence, bears #B <ADD~>.
The_projected	intersection of [new old] fences, a [barbed_wire chainlink electric wire wooden] fence, bears #B and a [barbed_wire chainlink electric wire wooden] fence, bears #B <ADD~>.

FROM_ WHICH_ FD

from which the [remains original] of [Esperson's Hall's Owens-Illinois the_original Sawyer_County] bearing tree(s) [4trees 3trees 2trees 1tree]

bearing tree(s) [4trees 3trees 2trees 1tree]

original

4trees

A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.)> ins. diam., bears #BD, [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~>. 3trees #3trees

3trees

A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.)> ins. diam., bears #BD, [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~>. 2trees #2trees

2trees

A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.)> ins. diam., bears #BD, [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~>. 1tree #1tree

1tree

A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.)> ins. diam., bears #BD, [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~>.

dim

stumphole, bears #BD <ADD~> [3trees 2trees 1tree done].

decayed

[black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce] indeterminant, bears #BD <ADD~>. [3trees 2trees 1tree done]

partially_decayed

[black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce] stump, <Diam.? (ins.)> ins. diam., bears #BD, [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at base <MARKED~>. [3trees 2trees 1tree done]

stump_hole

, bears #BD <ADD~>. [3trees 2trees 1tree done]

with_no_mks._visible

. <ADD~> [3trees 2trees 1tree done]

GOING	[East North South West] [along between] <SECTIONS? (#,#)> , T. [37 38 40 41] N., R. [6 7 8 9] W. <ADD~>
along	the [East North South West] of sec. <SECTION? (#)> , T. [37 38 40 41] N., R. [6 7 8 9] W. <ADD~>
HEADING	Group No. <Group #> Wisconsin. Temperature: <Degrees?> Fahrheit, [clear_skies cloudy_skies drizzle f_freezing overcast] conditions, PPM: <No.??> , #heading2
heading2	Gunman [Baker Kempe Wotruba-JR. Young], Mirrors [Baker Kempe Wotruba-JR. Young], Notes [Baker Kempe Wotruba-JR. Young], hero of the day: [Baker Kempe Wotruba-JR. Young].
LAKE	[Northerly Easterly Southerly Westerly] shore of [Blueberry_Lake Carpenter_Lake Chief_Lake Green_Lake Indian_Lake Lac_Courte_Oreilles Little_Round_Lake Grindstone_Lake Gurno_Lake Scott_Lake Spring_Lake Squaw_Lake Two_Boy_Lake Tyner_Lake] , bears #B and #B <ADD~> .
LINE_TREE	A [black decayed jack partially_decayed red sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce] [snag stump stump_hole], <Diam.? (ins.)> ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks_visible] blaze at breast_height <MARKED~> .
decayed	[black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce], size indeterminent, bears #BD <ADD~> . [3trees 2trees 1tree done]
partially_decayed	[black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce] stump, <Diam.? (ins.)> ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks_visible] blaze at base <MARKED~> . [3trees 2trees 1tree done]
with_no_mks_visible	. <ADD~> [3trees 2trees 1tree done]
MON_FD_CON	Monumented with a concrete post, <Size? (ins.)> ins. [sq. diam.], [firmly loosely] set, [projecting flush] <Ins. Above Ground?> ins. above ground, [and_in_a with] [collar mound]

<i>MON_FD_PIPE</i>	Mounted with [an_aluminum an_iron a_stainless_steel a_steel] [axle bolt pipe post rebar rod], <Diam.? (ins.)> ins. [sq. diam.], [firmly loosely] set, [projecting flush below], <Ins. Above Ground?> ins. above ground, [and_in_a with_no_mks.] [collar mound]
collar	of stone, [lying with with_no_mks.].
mound	of stone, <Diam.? (FT.)> ft. diam., <How High? (FT.)> ft. high, [lying with with_no_mks.]
flush	with the [ground surface], [and_in_a with_no_mks.] [collar mound]
with	[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks. visible steel_cap top] mkd. <Describe Cap Markings`>
with_no_mks.	visible <ADD`>.
a_drill_hole	on top <ADD`>
below	the [ground surface], <Ins. Below Ground?> ins., [with with_no_mks.] visible <ADD`>.
<i>MON_FD_STONE</i>	Monumented with a(n) [embedded_mound mound Set_stone] of stone, <Diam.? (FT.)> ft. diam. <ADD`>
mound	of stone, <Diam.? (FT.)> ft. diam., <How High? (FT.)> ft. high, [lying with with_no_mks.]
Set_stone	, <Size ? (Ins.)> ins., projecting <Ins. Above Ground?> ins. above ground, [and_in_a with_no_mks.] [collar mound]
collar	of stone, [lying with with_no_mks.].
with	[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks. visible steel_cap top] mkd. <Describe Cap Markings`>
with_no_mks.	visible <ADD`>.
a_drill_hole	on top <ADD`>

<i>MON_FD_WOOD</i>	Monumented with [a_cedar an_oak a_partially_decayed a_tamarack a_wood the_decayed] post, <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a with no_mks.] [collar mound]
<i>a_partially_decayed</i>	[cedar oak tamarack wood] post, <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a lying with no_mks.] [collar mound]
<i>the_decayed</i>	post <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a lying with no_mks.] [collar mound]
<i>lying</i>	alongside is the top portion of the post, <Diam.? (Ins.)> ins. [sq. diam.], <How Long ? (Ins.)> ins. long, [with no_mks.]
<i>with</i>	[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks. visible steel_cap top] mkd. <Describe Cap Markings>
<i>with_no_mks.</i>	visible <ADD>.
<i>a_drill_hole</i>	on top <ADD>
<i>PERMANENT_BS</i>	Nail in a <Diam.? (ins.)> ins. diam. [ash aspen balsam_fir birch cedar hemlock maple oak pine tamarack spruce] tree, bears <Bearing?> <Distance? (ft.)> <ADD>
<i>RAILROAD</i>	Center line of railroad [grade tracks], bears #B and #B <ADD>.

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<i>ROAD</i>	[Center_line Curve Edge Intersection] of [County_Highway Fire_Lane logging_road State_Highway] <Highway #> , <Width in Links?> lks. wide, bears #B and #B <ADD~> .
<i>Curve</i>	[PC PT along_curve] of [County_Highway Fire_Lane logging_road State_Highway] <Highway #> at the center line, <Width in Links?> lks. wide, bears #B and #B <ADD~> .
<i>Edge</i>	[north south east west] edge of [County_Highway Fire_Lane logging_road State_Highway] <Highway #> , <Width in Links?> lks. wide, bears #B and #B <ADD~> .
<i>Intersection</i>	of the center line of [County_Highway Fire_Lane logging_road State_Highway] <Highway #> , <Width in Links?> lks. wide, bears #B and #B, and the center line of [County_Highway Fire_Lane logging_road State_Highway] <Highway #> , <Width in Links?> lks. wide, bears #B and #B <ADD~> .
<i>RIVER</i>	[Left Right] bank of [Chippewa Couderay] River, course #B , and from #B <ADD~> .
<i>SWAMP</i>	[Enter Leave] [beaver Black_Ash Cedar Tamarack] [bog marsh pond swamp], bears #B and #B <ADD~> .
<i>SOLAR</i>	Solar taken at <Station Name?> by [Baker Kempe Wotruba-JR. Young] <ADD~> .
<i>STONE_WALL</i>	[Along Corner End] of a stone wall in [good poor] condition, approximately <Width in Feet?> ft. wide, standing <Height in Feet?> ft. high, bears #B and #B <ADD~> .
<i>TRAVERSE</i>	A [60_Penny_Nail natural driven_point PK_Nail] firmly set in [ground pavement] <ADD~> .
<i>natural</i>	tree, <Diam.? (ins)> ins., <Feet High?> ft. high <ADD~> .
<i>driven_point</i>	firmly set, <Diam.? (ins)> ins., <Feet High?> ft. high <ADD~> .
<i>TOPOCALL</i>	[Center Edge] of a [clear_cut gas_line field power_line], bears #B and #B <ADD~> .

A [fire_hydrant gas_line light power_pole power_line] <ADD~> .

THE The [N. E. W. S. meander_cor._of sec._cor. witness_cor.] 1/4 sec. cor. of secs. <SECTIONS? (# and #)> <ADD~>
sec._cor. of <SECTIONS? (#,#,#, and #)> <ADD~>
meander_cor._of secs. <SECTIONS? (#,#)> <ADD~>
witness_cor. of secs. <SECTIONS? (#,#)> <ADD~>

THIS_COR._POSITION This cor. [is_accepted was_established was_perpetuated was_recorded was_reestablished] [by
is_accepted by_person(s)_unknown. using_improper]
as_a_careful [as_having_been as_a_careful] [established reestablished] in good faith using proper methods and procedures.
by and faithful [perpetuation determination] of the original cor. position.
[Edward_Gobler Fritz Gobler Harry Johnson Otto Gobler Ronald Peterson William Stuth] [Registered_Land_Surveyor
Sawyer_County_Surveyor], in <YEAR?> , recorded in the Sawyer County Courthouse, and is accepted as a carefull and
faithful [perpetuation reestablishment determination] of the original cor. position.
using_improper procedures and was not utilized in the course of this resurvey.

Point for the [center cor._of_sec. meander_cor. N-N S-N N-S S-S NE SE SW NW N. E. W. S.] [1/4 sec. 1/16 sec. 1/64 sec.] cor. of secs. <SECTIONS? (# and #)> , at proportionate dist; there is no remaining evidence of the original cor.

cor._of_sec.

<SECTIONS? (#,#,#, and #)> , at proportionate dist.; there is no remaining evidence of the original cor.

1/16 sec.

cor. of [secs. sec.] <SECTIONS? (# and #)> <ADD~> .

sec.

<SECTION? (#)> , at the intersection with E. and W. center line of the [NE SE SW NW] 1/4 of sec. <SECTION? (#)> <ADD~>

1/64 sec.

cor. of secs. <SECTIONS? (# and #)> <ADD~> .

meander_cor.

of secs. <SECTION? (# and #)> , at proportionate dist.; there is no remaining evidence of the original cor.

center

[1/4 N_1/16 E_1/16 S_1/16 W_1/16] of sec. <SECTION ? (#)> <ADD~>

1/4

of sec. <SECTION? (#)> , at intersection with the E. and W. center line.

FROM_WHICH_FD from which the [remains original] of [Esperson's Hall's Owens-Illinois the_original Sawyer_County] bearing tree(s) [4trees 3trees 2trees 1tree]

original bearing tree(s) [4trees 3trees 2trees 1tree]

4trees A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.) > ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~> . 3trees #3trees

3trees A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.) > ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~> . 2trees #2trees

2trees A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.) > ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~> . 1tree #1tree

1tree A [black decayed dim jack partially_decayed red scotch sugar white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce tamarack] [snag stump stump_hole], <Diam.? (ins.) > ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at [base base_and_breast_height breast_height] <MARKED~> .

dim stumphole, bears #BD <ADD~> [3trees 2trees 1tree done].

decayed [black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce], size indeterminent, bears #BD <ADD~> . [3trees 2trees 1tree done]

partially_decayed [black jack red scotch sugar tamarack white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine spruce] stump, <Diam.? (ins.) > ins. diam., bears #BD , [mkd. with_healed with_partially_healed with_open with_no_mks._visible] blaze at base <MARKED~> . [3trees 2trees 1tree done]

stump_hole , bears #BD <ADD~> . [3trees 2trees 1tree done]

with_no_mks._visible . <ADD~> [3trees 2trees 1tree done]

Monumented with a concrete post, <Size? (ins.) > ins. [sq. diam.], [firmly loosely] set, [projecting flush] <Ins. Above Ground? > ins. above ground, [and_in_a with] [collar mound]

Moumented with [an_aluminum an_iron a_stainless_steel a_steel] [axle bolt pipe post rebar rod], <Diam.? (ins.) > ins. [sq. diam.], [firmly loosely] set, [projecting flush below], <Ins. Above Ground? > ins. above ground, [and_in_a with no_mks.] [collar mound]

collar

of stone, [lying with with_no_mks.].

mound

of stone, <Diam.? (FT.) > ft. diam., <How High? (FT.) > ft. high, [lying with with_no_mks.]

flush

with the [ground surface], [and_in_a with with_no_mks.] [collar mound]

with

[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks. visible steel_cap top] mkd. <Describe Cap Markings~ >

with_no_mks.

visible <ADD~ > .

a_drill_hole

on top <ADD~ >

below

the [ground surface], <Ins. Below Ground? > ins., [with with_no_mks.] visible <ADD~ > .

<i>MON_FD_STONE</i>	Monumented with a(n) [embedded_mound mound Set_stone] of stone, <Diam.? (FT.)> ft. diam. <ADD~>
mound	of stone, <Diam.? (FT.)> ft. diam., <How High? (FT.)> ft. high, [lying with with_no_mks.]
Set_stone	, <Size ? (Ins.)> ins., projecting <Ins. Above Ground?> ins. above ground,[and_in_a with with_no_mks.] [collar mound]
collar	of stone, [lying with with_no_mks.].
with	[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks._visible steel_cap top] mkd. <Describe Cap Markings~>
with_no_mks.	visible <ADD~>.
a_drill_hole	on top <ADD~>
<i>MON_FD_WOOD</i>	Monumented with [a_cedar an_oak a_partially_decayed a_tamarack a_wood the_decayed] post, <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a with with_no_mks.] [collar mound]
a_partially_decayed	[cedar oak tamarack wood] post, <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a lying with with_no_mks.] [collar mound]
the_decayed	post <Diam.? (Ins.)> ins. [sq. diam.], [projecting flush below] <Ins. Above Ground?> ins. above ground, [and_in_a lying with with_no_mks.] [collar mound]
lying	alongside is the top portion of the post, <Diam.? (Ins.)> ins. [sq. diam.], <How Long ? (Ins.)> ins. long, [with with_no_mks.]
with	[aluminum_cap. a_drill_hole brass_cap faint_scribe_mks. iron_cap mks. plastic_cap no_mks._visible steel_cap top] mkd. <Describe Cap Markings~>
with_no_mks.	visible <ADD~>.
a_drill_hole	on top <ADD~>

MON_SET

[Seat Set] a brass tablet, 3 1/4 ins. diam., 3 in. stem in drill hole, filled with concrete, flush with [asphalt concrete ledge rock], over a "DEEP-1", with top mkd. <ADD~>

Set

[an_aluminum a_stainless_steel] [post sectional_rod], 30 ins. long, 2 1/2 ins. diam., <Deep? (Ins.)> ins. in the ground, over a "DEEP-1", [in_a_collor mound_of with_brass] cap mkd. <ADD~>

mound_of

stone, <Diam.? (FT.)> ft. diam., <How High? (FT.)> ft. high, with aluminum cap mkd. <ADD~>

sectional_rod

<LONG (INS.)?> ins. long, 5/8 in. diam., driven <Driven? (Ins.)> ins. in the ground, with a "DEEP-1" alongside, [in_a_collor mound_of with_aluminum] cap mkd. <ADD~>

in_a_collar

of stone, with an aluminum cap mkd. <ADD~>

CAP [angle_point_marking rectangular_marking] [exterior interior] [meander standard sub_section] #controls:

Lines From Center: [2 3 4] #B #3
#B #2

CAP
angle_point_marking

3

2 #B #B <Marked ?~> <Year ?>

meander

[⌈≡ ≡ | - |] S < East Sec. ?> S < West Sec. ?> #B < Year ?>

S < North Sec. ?> S < South Sec. ?> #B , < Year ?>

S < East Sec. ?> S < West Sec. ?> #B , < Year ?>

S < North Sec. ?> S < South Sec. ?> #B , < Year ?>

S < Section ?> [Regular Elongated_North Elongated_West] [Center 1/16] < Year ?>

sub_section

<Elongated Dist ?> [Center East West] [1/16 1/64] < Year ?>

Elongated_North

<Elongated Dist ?> [Center North South] [1/16 1/64] < Year?>

Elongated_West

[CE CN CS CW NE NW SE SW] < Year ?>

1/16

exterior

#controls:

[1_section 2_sections 3_sections 4_sections] [⌈⌊ ⌋ ⌋] S < Interior Section ?> S < Exterior Section ?> < Year ?>

controls:

[— |] S < East Sec. ?> S < West Sec. ?> [1/4 1/16 1/64 1/256 1/1024 POL WC WP _] < Year ?>

2_sections

S < North Sec. ?> S < South Sec. ?> [1/4 1/16 POL WC WP _] < Year ?>

—

[⌈⌊ — | — |] S < North Sec. ?> S < East Sec. ?> S < West Sec. ?> [CC WC SC _] < Year ?>

3_sections

S < North Sec. ?> S < South Sec. ?> S < West Sec. ?> [CC WC SC _] < Year ?>

⌈

S < East Sec. ?> S < South Sec. ?> S < North Sec. ?> [CC WC SC _] < Year ?>

⌋

S < East Sec. ?> S < South Sec. ?> S < West Sec. ?> [CC WC SC _] < Year ?>

⌊

⌋ S < NE Sec. ?> S < SE Sec. ?> S < SW Sec. ?> S < NW Sec. ?> < Year ?>

4_sections

<i>FROM WHICH</i>	[and_new_bearing from_which from_which_new_bearing] trees [4-trees 3-trees 2-trees 1-tree]
from_which	[4-trees 3-trees 2-trees 1-tree]
4-trees	A [black jack red scotch sugar power none white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine pole spruce tamarack], < Diam.? (ins.) > ins. diam., bears #BD, [mkd. with_nail_at_base] < MARKED > . 3-trees #3-trees
3-trees	A [black jack red scotch sugar power none white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine pole spruce tamarack], < Diam.? (ins.) > ins. diam., bears #BD, [mkd. with_nail_at_base] < MARKED > . 2-trees #2-trees
2-trees	A [black jack red scotch sugar power none white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine pole spruce tamarack], < Diam.? (ins.) > ins. diam., bears #BD, [mkd. with_nail_at_base] < MARKED > . 1-tree #1-tree
1-tree	A [black jack red scotch sugar power none white yellow] [ash aspen balsam_fir birch cedar hemlock maple oak pine pole spruce tamarack], < Diam.? (ins.) > ins. diam., bears #BD, [mkd. with_nail_at_base] < MARKED > .
<i>FROM THIS</i>	From this cor., a <Describe >, bears #BD .
<i>THIS COR.</i>	This cor. is located #BD, from <Describe > .
<i>BURY</i>	Bury the [aluminum concrete iron wood] [pipe post rebar stone] alongside the [aluminum stainless_steel] [post rod] < ADD > .

R'S CARD

0051323

1998
ctronic field
ensive

	OFFICE	DATE RETURNED

(Continued on reverse)

GA 109.5 .C322 1998
Cadastral electronic field
book comprehensive

